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Dec 11
Rev 1.1

Response to Comment No. 30

During the construction of Detention Basin #2, evidence of Quarry No. 4 was encountered at the location where the outfall was originally planned for installation. Therefore, the outfall was extended about 25 feet to the south/southeast so that it was outside the limits of Quarry No. 4. Figure 1-1 that was included in the Quarry No. 4 Work Plan showed the original proposed location of the outfall. The attached Figure 1-1 shows the revised limits of Quarry No. 4 and the location at which the outfall for Detention Basin #1 was ultimately installed.

EPA's Comment No. 31

Section 2.2, Results of Soil Samples Obtained from Quarry No. 4, Page 2-3. Penn E&R should explain their method for calculating the mean soil concentrations for each compound and metal. Apparently, the simple arithmetic mean of all available data was calculated. The EPA Soil Screening Guidance User's Guide (pp. 16-17), however, directs that a mean concentration should be calculated for each soil boring, and that the highest mean soil boring concentration within the source should form the basis for deciding whether to further investigate a source area, "reflecting the conservative assumption that the highest mean subsurface soil boring concentration among a set of borings taken from the source area represents the mean of the entire source area" (p. 16). The method for calculating the average concentration for each boring is given on page 17 of the User's Guide. The significance of this different calculation method is not readily apparent (it may not change any of the conclusions), but, if this was not how the means were calculated, then the means should be recalculated to be consistent with EPA guidance.

Response to Comment No. 31

The mean concentrations included in original Table 2-1 represent the simple arithmetic mean for the twenty-two soil samples collected from Quarry No. 4. The simple arithmetic mean was used to compensate for the fact that multiple soil samples were collected from only four of the sixteen soil borings/test trenches installed in the quarry. Eight of twenty-two soil samples collected from the quarry were obtained from these four borings (i.e., samples Q4-B1-18-20 and Q4-B1-78-80 from boring Q4-B1, samples Q4-B2-6-8 and Q4-B2-40-42 from boring Q4-B2, samples SB-1-14-16 and SB-1-55-57 from boring SB-1, and samples SB-2-42-44 and SB-2-42-44 from boring SB-2).

However, as requested, Penn E&R has recalculated the "mean" concentration following the procedures included on pages 16 and 17 of the EPA's Soil Screening Guidance User's Manual. The attached revised Section 2.0 for the Quarry No. 4 Work Plan has been modified to reflect this change. In addition, because a majority of the soil results from Quarry 4 were obtained from single-sample borings, to ensure a conservative evaluation of the entire data set, the maximum concentrations of certain compounds were used for comparison purposes when the maximum concentration was not used to calculate the mean concentration (i.e., the maximum concentration

for a particular compound was not detected in one of the eight samples used to calculate the mean concentrations). As discussed in revised Section 2.0, this worst-case evaluation results in a few organics and certain additional inorganics being present above EPA site-specific soil-screening-levels (SS SSLs) in the soil samples collected from Quarry No. 4. Therefore, the Preliminary List of Potential Contaminants of Concern to be further evaluated as part of the Demonstration Project has been revised.

EPA's Comment No. 32

Section 2.2, Background Metal Results for Soil. EPA has not accepted the background data referenced in this section. Please see the corresponding comment number 6 under Appendix B.

Response to Comment No. 32

As indicated in the attached revised Section 2.2 for the Quarry No. 4 Work Plan, the discussion of the comparison of Quarry No. 4 soil sample metal results to the background metal concentrations developed by Oxford and ERM has been removed. The PRP Group, as part of its work on other portions of the Site, is proposing to do a statistical analysis of background soil results previously developed by Oxford and ERM. As discussed in revised Section 4.1, Penn E&R proposes to compare the results of the PRP evaluation of the background soil sample results to the Quarry No. 4 sample results. The results of this comparison will be used to determine which metals fall within background levels and do not need to be included as COC in the ground water monitoring program.

EPA's Comment No. 33

Section 2.2, Results of Soil Samples Obtained from Quarry No. 4. Boring logs from samples shown in Table 2-1 should be included as an appendix. Consideration should be given to include the samples of nearby borings by Pennoni Associates in 1993 (PB-2, PB-6, PB-7) in the data evaluation.

Response to Comment No. 33

As requested, lithologic logs for the borings installed in Quarry No. 4 are included in Attachment 2A, which has been added to the attached revised Section 2.0 for the Quarry No. 4 Work Plan. Penn E&R does not believe that Pennoni borings PB-2, PB-6 and PB-7 should be included in the evaluation of data generated for Quarry No. 4. These borings were reportedly installed in Area 6, which is clearly not part of or in any way associated with Quarry No. 4. Area 6 is being addressed separately as part of work proposed by the PRP Group.

EPA's Comment No. 34

Section 2.4, Preliminary List of Potential Contaminants of Concern, Page 2-7. Note that the recalculation of the mean soil boring concentrations from the previous comment, may potentially result in the creation of VOC and SVOC contaminants of concern.

Response to Comment No. 34

See response to Comment No. 31.

EPA's Comment No. 35

Section 2.4, Preliminary List of Potential Contaminants of Concern, Page 2-7. Given the presence of actual groundwater data, it is not clear why Soil SSLs are being used to develop groundwater COCs. Also, it may not be appropriate to omit any metals from the monitoring program at this point of the study (i.e., attribute them to ambient or background conditions), when the background investigation for the site groundwater has yet to be conducted. It is suggested that all metals be included in the Quarry 4 analysis until the determination of background groundwater conditions is finalized and accepted by EPA (similar to the text discussion on page 2-8, last paragraph, and page 4-3, first full paragraph).

Response to Comment No. 35

Because the purpose of the Demonstration Project is to support a request to waive the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry, Penn E&R used soil SSLs in conjunction with the ground water sample results to conservatively screen out those compounds whose presence in groundwater could not be attributed to leaching from Quarry 4 materials. That is, if the mean concentration, or in some cases its maximum concentration, for a particular contaminant was not detected in the soil samples collected from Quarry No. 4 above its conservative EPA SS SSL or above its EPA MCL in the ground water samples collected from wells located downgradient of the quarry, Penn E&R did not include this compound on the Preliminary List of Potential Contaminants of Concern since it has not nor could not be leached from the soil in Quarry No. 4 to the ground water at unacceptable levels.

The final list of Potential Contaminants of Concern will be determined after the statistical analysis of background metal concentrations in soils, as discussed in the attached revised Section 4.1 of the Quarry No. 4 Work Plan, has been completed, and the results of the PRP's proposed background investigation of ground water has been completed and accepted by EPA. The final list of Potential Contaminants of Concern to be evaluated as part of the groundwater monitoring program will be included in the Interim Remedial Design Report.

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EPA's Comment No. 36

Section 4.1, Hydrogeologic Evaluation, Page 4-1. *It is important that the geologic cross-section discussed in the text be constructed as a hydrogeologic cross-section (this may already be the case, but it is not specifically stated in the text). The cross-section should post the hydraulic head values for each screen interval included in the section, and these data should be contoured to illustrate the interpreted vertical distribution of hydraulic head (and vertical component of groundwater flow) in the vicinity of Quarry 4. Additionally, the cross-sections should indicate the types of soil used to fill the quarry, the inferred bottom of the quarry where a transition to undisturbed formations occurs.*

Response to Comment No. 36

The attached revised Section 4.1 of the Quarry No. 4 Work Plan has been revised to reflect EPA's Comment No. 36. The geologic cross-sections will be constructed as hydrogeologic cross-sections and will include all appropriate hydrogeologic information (i.e., hydraulic head values for each screened interval, vertical flow gradients, etc.), the types of soil used to fill Quarry No. 4, and the inferred bottom of the quarry where a transition to undisturbed formations occurs.

EPA's Comment No. 37

Section 4.2, Task 2 - Evaluation of Soils Used as Cover at Quarry No. 4, Page 4-3. *It is recommended that any perched water encountered during installation of soil borings be sampled for full TCL organics and TAL metals.*

Response to Comment No. 37

As requested by EPA and indicated in the attached revised Section 4.2 for the Quarry No. 4 Work Plan, if perched water is encountered during the installation of soil borings through the soil cover over Quarry No. 4, it will be sampled. If encountered, a perched water sample will be collected from only one of the three soil borings to be installed. This sample will be submitted for laboratory analysis of the Target Compound List volatile and semivolatile organic compounds and the TAL inorganics (i.e., metals and cyanide). As the perched water sample will be collected from a soil boring, it is likely that the sample will be very turbid, even if, as proposed in the revised Section 4.2 for the Quarry No. 4 Work Plan, the sample is collected from a temporary well point. Therefore, Penn E&R recommends that the water sample be analyzed for dissolved metals rather than total metals.

EPA's Comment No. 38

Section 4.3, Task 3 - Groundwater Monitoring Program, Page 4-6. *Consideration should be given to include proposed well 19S in the monitoring program.*

Quarry No. 4
Right

Response to Comment No. 38

As indicated in the attached revised Section 4.3 for the Quarry No. 4 Work Plan, well MW-19S, which is proposed to be installed by the PRP Group, will be incorporated into the ground water monitoring program. The proposed location at which well MW-19S will be installed is shown on revised Figure 2-1.

EPA's Comment No. 39

Section 4.3, Task 3 - Groundwater Monitoring Program, Page 4-6. In the "Data Analysis" subheader the report indicates that ANOVA statistical procedures are to be used in analyzing the groundwater monitoring data. It should be noted that Gibbons (1994) indicated pitfalls/drawbacks (i.e., multiple constituent and false positive rates, spatial variability, and sample size) that must be considered when utilizing ANOVA for use in analyzing upgradient and downgradient chemical concentrations. Additionally, it should be noted that a significant ANOVA test result will not indicate which well or wells is/are potentially contaminated without post-hoc testing. When the above drawbacks exist at a site, possible alternatives are: retesting with parametric (or nonparametric) intervals (U.S. EPA, 1992) and intrawell analysis (Horsey et al., 2000; Chou et al., 2001). It is recommended that these potential pitfalls/drawbacks be built in to the flow chart (Figure 4-2) with alternatives recommended when encountered.

Additionally, tests for trends in a single well or along flow paths could also provide some useful information about what is happening at the site. The procedures to use include linear regression, nonparametric regression, Sen's slope estimate, Mann-Kendall tests, seasonal Kendall tests, and Sen's test for trends. These procedures are usually performed on single compounds or grouped compounds such as BTEX and are used to identify if a plume is stable, increasing in size, or shrinking.

Response to Comment No. 39

The attached Section 4.3 for the Quarry No. 4 Work Plan has been revised to include other possible statistical methods that may be used to evaluate the groundwater data if pitfalls/drawbacks, such as those referred in EPA's Comment No. 39, are encountered.

EPA's Comment No. 40

Section 5.2.2.5, Well Sampling, Page 5-8. If the low-flow sampling method will be employed, why are both total and dissolved metals samples being collected. Given the disagreements concerning the use of filtered metals data that arose during the RI, the work plan should discuss why filtered samples are being taken, and how these data will be used. Also, the work plan should discuss the filtering procedures to be employed.

July 9, 2002

07-11-02
16:00

Response to Comment No. 40

Penn E&R believes that the ground water samples to be collected as part of the Quarry No. 4 Demonstration Project should be analyzed for both total and dissolved metals. This approach is consistent with past sampling events completed at the Site by the PRP Group, including the most recent round of sampling that was completed in May 2001. The samples collected by the PRP Group in May 2001 were obtained using a low-flow sampling method, which is the sampling method that will be used to collect the ground water samples as part of the Quarry No. 4 Demonstration Project. Because the Demonstration Project will make use of historical as well as future sampling data, Penn feels that the collection of samples for both total and dissolved metals is useful. The attached revised Section 5.2.2.5 of the Quarry No. 4 work plan has been revised to indicate the filtering procedures to be employed.

We have enclosed three copies of the various Sections, Figures, Tables, and Attachments for the Quarry No. 4 Work Plan that were revised in response to the EPA's review comments. These include the Table of Contents, Sections 2.0, 4.0 and 5.0, Figures 1-1, 2-1, 3-1, 4-1 and 5-1, Tables 2-1, 5-1, 5-2 and 5-3, and Attachment 2A. Please replace the relevant sections of the October 11th submittal with these revised sections.

Should you have any questions regarding the contents of this letter or any revisions that were made to the Quarry No. 4 Work Plan, or if you require additional information, please do not hesitate to call us.

Sincerely,

PENN ENVIRONMENTAL & REMEDIATION, INC.



Michael A. Christie, P.G.
Vice President

MAC:dle
Enclosure
4013:epaq4rl

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- EXISTING QUARRY AREA
- APPROXIMATE QUARRY LIMITS
- APPROXIMATE QUARRY LIMITS



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FIGURE 1-1
SITE LAYOUT MAP FOR 2201/2301
RENAISSANCE BOULEVARD SHOWING
THE APPROXIMATE LIMITS
OF QUARRY NO. 4

APPROVED: 02 OCT 01 DATE: _____

PENNER DRAWING NO: 4236-034 (5) FIGURE NO: _____ REV: _____

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2.0 BACKGROUND INFORMATION

2.1 History of Quarry No. 4

Existing information suggests that Quarry No. 4 was mined for sand and gravel from sometime in the 1800s until the early 1900s. Based on a review of historical aerial photographs, the quarry was inactive and filled with water between at least 1945 and 1959. A 1965 aerial photograph shows that Quarry No. 4 was being filled with what appears to be earthen material. There may have been some water still present in the center of the quarry at this time. Between 1965 and 1975, it appears that the quarry was being actively filled with earthen material. By 1980, the quarry appears to have been filled to grade. The 1980 photograph shows that there is vegetation present on the surface of the quarry and there are also dirt access roads present in the central portion of the quarry and along its southeast end. There appears to have been some minor filling/grading-taking place on the surface of the quarry in 1985. No activities were evident on the quarry in 1990 or 1995. By 1995, the surface of the quarry was covered with vegetation. The elevation of the surface of the backfilled quarry generally ranges from about 127 feet to 130 feet above mean sea level. Based on the above, it appears that fill materials have been in place in the quarry for approximately 35 years.

2.2 Results of Soil Samples Obtained from Quarry No. 4

Boring Installation and Soil Sampling

There have been three investigations of the contents of Quarry No. 4 since the early 1990s. Pennoni Associates, Inc. (Pennoni) performed the first investigation in 1993. As part of this investigation, Pennoni installed four soil borings in the quarry. These borings were designated PB-1, and PB-3 through PB-5. Boring PB-1 was completed at a depth of 32 feet below the ground surface (BGS), boring PB-3 was completed at a depth of 52 feet BGS, boring PB-4 was completed at a depth of 72 feet BGS, and boring PB-5 was completed at a depth of 52 feet BGS. The approximate locations at which these borings were installed are shown on Figure 2-1. The borings were installed using a hollow-stem auger-drilling rig. To evaluate the materials within and immediately below the quarry, Pennoni selected and submitted four samples for laboratory analysis. The samples selected for analysis were collected as follows: 1) from 27 to 29 feet BGS in boring PB-1; 2) from 10 to 12 feet BGS in boring PB-3; 3) from 35 to 37 feet BGS in boring PB-4; and 4) from 50 to 52 feet BGS in boring PB-5. The four samples were analyzed for the Target Compound List (TCL) organics (i.e., volatile and semi-volatile organic compounds and pesticides/PCBs) and the Target Analyte List (TAL) inorganics (i.e., metals and cyanide).

The Crater Resources PRP Group completed a Remedial Investigation/Feasibility Study (RI/FS) of the Crater site between 1996 and 1999. Quarry Nos. 1 through 3, which received WAL were the primary focus of the RI/FS. As shown on Figure 2-1, these quarries are located south and west of the 2201 and 2301 properties. (Quarry No. 1 is not shown on Figure 2-1 but it is located approximately 1,200 feet west of Quarry No. 2.) Although Quarry No. 4 never reportedly directly received WAL from the pipeline that was used to pump WAL into Quarry Nos. 1 through 3, Quarry No. 4 was investigated as part of the RI/FS.

As part of the RI/FS investigation, six soil samples were collected from Quarry No. 4. These samples were designated Q4-1 (0 to 0.5 feet BGS), Q4-2 (0 to 0.5 feet BGS), Q4-B-1 (18 to 20 feet BGS), Q4-B-1 (78 to 80 feet BGS), Q4-B-2 (6 to 8 feet BGS), and Q4-B-2 (40 to 42 feet BGS) and were collected from the approximate locations shown on Figure 2-1. Soil samples Q4-1 and Q4-2 were collected directly from the surface of the quarry with the remaining four samples collected at depth from two soil borings (Q4-B1 and Q4-B2) installed using a hollow-stem auger drilling rig. Boring Q4-B1 was completed at a depth of 80 feet BGS and boring Q4-B2 was completed at a depth of 42 feet BGS. The six soil samples were analyzed for the TCL organics (i.e., volatile and semivolatile organic compounds and pesticides/PCBs) and the TAL inorganics (i.e., metals and cyanide).

In 1998, Penn E&R was retained by Liberty to complete a further investigation of Quarry No. 4. As part of this investigation, Penn E&R installed eight test trenches and two soil borings in the quarry. The test trenches were designated T-1 through T-8 and the borings SB-1 and SB-2. The test trenches were generally excavated to a depth of 15 feet BGS in an effort to evaluate fill/soil conditions in the upper levels of the quarry. Borings SB-1 and SB-2 were completed at depths of 69 feet and 82 feet BGS, respectively. These test trenches and borings were installed at the approximate locations shown on Figure 2-1. To evaluate the quality of the contents of the quarry, Penn E&R submitted twelve soil samples for laboratory analysis. These samples were designated SB-1 (14 to 16 feet BGS), SB-1 (55 to 57 feet BGS), SB-2 (10 to 12 feet BGS), SB-2 (42 to 44 feet BGS), Q4-T1 (2 feet BGS), Q4-T2 (2 feet BGS), Q4-T3 (2 feet BGS), Q4-T4 (2 feet BGS), Q4-T5 (2 feet BGS), Q4-T6 (15 feet BGS), Q4-T7 (13 feet BGS), and Q4-T8 (2 feet BGS). These twelve samples were analyzed for the TCL volatile and semivolatile organic compounds and the TAL inorganics. In addition, four of the samples (the SB designated samples) were also analyzed for pesticides and PCBs.

Copies of the lithologic logs developed for the borings installed in Quarry No. 4 by ERM, (Q4-B1 and Q4-B2), Pennoni (PB-1 and PB-3 through PB-5) and for the test trenches (T-1 through T-8) and borings (SB-1 and SB-2) installed by Penn E&R are included in Attachment 2A.

Sample Results

The results of the analysis of the twenty-two soil samples collected from Quarry No. 4 as part of the aforementioned investigations are summarized in Table 2-1. In evaluating the soil sample analytical data, a mean concentration was calculated for each compound following the procedures included on pages 16 and 17 of the EPA's Soil Screening Guidance User's Manual (USEPA, July 1996). The mean concentration presented in Table 2-1 represents the highest mean concentration calculated for the four soil borings from which more than one sample was collected (i.e., samples Q4-B1-18-20 and Q4-B1-78-80 from boring Q4-B1, samples Q4-B2-6-8 and Q4-B2-40-42 from boring Q4-B2, samples SB-1-14-16 and SB-1-55-57 from boring SB-1, and samples SB-2-42-44 and SB-2-42-44 from boring SB-2). Because only a single soil sample was collected from a majority of the borings installed in Quarry 4, the EPA's Soil Screening Guidance Manual procedures could not be strictly implemented for these borings. Therefore, to ensure a conservative evaluation, the maximum concentration found in the samples from the single-sample borings is also provided in Table 2-1 for comparison purposes, unless the maximum concentration occurred in a multiple-sample borings.

Original
1/16/14

In evaluating the soil data in Table 2-1, a conservative approach was utilized whereby the calculated highest mean concentrations and, for some compounds, the maximum concentrations were compared to site-specific soil-to-groundwater soil screening levels (SS SSLs) developed for Quarry No. 4 (as presented in Table 32 of the Remedial Investigation Report for the Crater site), default SSLs where site specific values were not available and non-residential, used-aquifer, soil-to-groundwater Medium Specific Concentrations (NRSG MSCs) developed pursuant to Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2). Penn E&R believes that the use of the site-specific SSLs presented in Table 2-1, and the default SSLs where site specific values were not available, provide a very conservative evaluation of potential impacts to ground water. This is because the calculation of the Migration to Groundwater SSLs as described in the Exhibit 12 of the Screening Guidance User's Manual uses simplifying assumptions, which ensure calculated values are extremely conservative such that no further study is required under CERCLA for compounds identified at concentrations less than the SSLs. These assumptions include the following:

- Infinite source (i.e., steady-state concentrations are maintained over the exposure period).
- Uniformly distributed contamination from the surface to the top of the aquifer
- No contaminant attenuation (i.e., adsorption, biodegradation, chemical degradation) in soil
- Instantaneous and linear equilibrium soil/water partitioning
- Unconfined, unconsolidated aquifer with homogeneous and isotropic hydrologic properties
- Receptor well at the downgradient edge of the source and screened within the plume
- No contaminant attenuation in the aquifer

Therefore, use of these SSLs to identify the preliminary contaminants of concern (COC) to be further evaluated as part of the Demonstration Project, as described below, is particularly conservative and is an appropriate methodology for identifying those contaminants with the potential to be leached from the contents of Quarry 4. Also, as indicated above, maximum concentrations were used for some compounds for screening purposes, which again provides a very conservative evaluation of potential impacts to the groundwater. A detailed discussion of the evaluation of the soil sample analytical results is provided below.

Volatile Organic Compounds

No volatile organic compounds were detected above their Act 2 MSCs in the twenty-two soil samples collected from Quarry No. 4. Also, with the exception of trichloroethene (TCE) and tetrachloroethene (PCE) in one sample, no volatile organic compounds were detected above their EPA SS SSLs. TCE and PCE were detected just above their EPA SS SSL of 0.01 milligrams per kilogram (mg/kg) and 0.03 mg/kg, respectively, in the sample collected from 18 to 20 feet BGS at sample location Q4-B-1. These compounds were not detected above EPA SS SSLs in the deep sample collected from boring Q4-B-1, which suggest that neither TCE nor PCE is being mobilized by conditions in Quarry No. 4, as they are not being leached from the shallow to the deep soils in the quarry. As shown in Table 2-1, the mean concentration for TCE exceeds its EPA SS SSL of 0.01 mg/kg. However, the calculated mean concentration for PCE does not exceed its EPA SS SSL of 0.03 mg/kg. Maximum concentrations were not used for comparison

purposes since the maximum concentrations for these compounds were used to calculate their respective mean concentrations in accordance with EPA guidance.

Based on the above and in accordance with the Soil Screening Guidance, TCE will be included in the preliminary list of COC to be further evaluated as part of the Demonstration Project.

Semivolatile Organic Compounds

No semivolatile organic compounds were detected above their Act 2 NRSG MSCs in the twenty-two soil samples collected from Quarry No. 4. Also, the mean concentrations calculated for the detected semivolatile organic compounds did not exceed their EPA SS SSLs. The maximum concentration for the compounds benzo(a)anthracene, benzo(b)fluoranthene and carbazole were detected just above their EPA SS SSLs in the sample collected from the 10-12 foot interval in boring PB-3. Since only one soil sample was collected from this boring, these results were not included in determining the mean concentrations and, as a result, the maximum concentrations of these compounds were used for comparison purposes. Based on the above, the semivolatile organic compounds benzo(a)anthracene, benzo(b)fluoranthene and carbazole will be included in the preliminary list of COC to be further evaluated as part of the Demonstration Project.

Pesticides/PCBs

As shown in Table 2-1, neither the calculated mean concentrations nor the maximum concentrations, where maximum concentrations were used in-place of the means, for any of the pesticides or PCBs were detected above their Act 2 NRSG MSC or EPA SS SSL in the soil samples obtained from Quarry No. 4. Therefore, in accordance with the Soil Screening Guidance, no further investigation of pesticides/PCBs is warranted.

Inorganics

Cyanide (total)

Cyanide was not detected above its Act 2 NRSG MSC in any of the twenty-two soil samples obtained from Quarry No. 4. However, the calculated mean concentration for cyanide exceeds its SS SSL of 8 mg/kg. Based on these results and as discussed below, cyanide will be included in the preliminary list of COC to be further evaluated as part of the ground water Demonstration Project.

Metals

As shown in Table 2-1, neither the mean concentrations nor the maximum concentrations, where maximum concentrations were used in-place of means, for the following metals were detected above EPA SS SSLs or PADEP MSCs in the twenty-two soil samples collected from Quarry No. 4:

- Aluminum
- Antimony

Continued
Here

- Beryllium
- Cadmium
- Cobalt
- Copper
- Nickel
- Silver
- Zinc

Therefore, in accordance with the Soil Screening Guidance, these metals do not warrant further investigation. Either the mean concentrations or the maximum concentrations, where the maximum concentrations were not used to calculate the means, for the metals arsenic, barium, chromium, cobalt, iron, lead, manganese, mercury, selenium, thallium, and vanadium were detected above EPA SS SSLs. Based on the above and in accordance with the Soil Screening Guidance, these metals will be included in the preliminary list of COC to be further evaluated as part of the Demonstration Project.

Background Metal Results For Soils

In December of 2,000, Oxford Engineers and Consultants, Inc. provided a letter to the USEPA that outlined the results of background soil sampling that they had completed as part of remedial activities being implemented on other portions of the Crater site. Oxford collected twelve soil samples and analyzed them for the metals aluminum, arsenic, chromium, iron and manganese as well as polynuclear aromatic hydrocarbons (PAHs) and pesticides. These samples were designated BKG-1 through BKG-12. The metal results for these samples are summarized in Table 2-2.

In addition, as part of the Crater Remedial Investigation, Environmental Resources Management collected six soil samples for evaluating background soil conditions. These samples were analyzed for the TCL volatile and semivolatile organics and PCBs and the TAL metals. These samples were designated B-3 through B-8. The results of the metal results for these samples are also summarized in Table 2-2.

A review of Table 2-2 shows that the two data sets are rather consistent. As indicated above, the mean/maximum concentrations for some metals were detected above their EPA SS SSLs in soil samples collected from Quarry No. 4. The mean/maximum concentrations and SS SSLs for some of these metals (i.e., aluminum, arsenic, chromium, and manganese) fall within the Oxford and ERM background concentration ranges included in Table 2-2. Therefore, as discussed in Section 4.0, the results of the statistical evaluation of the Oxford and ERM background metal results proposed to be completed by the PRP Group will be used to determine what metals detected in Quarry No. 4 fall within background levels. Those metals that are determined to fall within background levels will be eliminated from the list of preliminary COC to be included in the groundwater-sampling program proposed as part of this Work Plan.

2.3 Groundwater Conditions

Based on the results of the RI/FS, while the groundwater hydraulic gradient is in a northeasterly direction, groundwater flow in the area of Quarry No. 4 is believed to be primarily to the east as shown on Figure 2-1 due to the low transmissivity of the unconsolidated soils north of the quarries and the steeply dipping limestone beds beneath this area. The wells installed as part of the RI/FS that are located closest to and hydraulically downgradient of Quarry No. 4 include wells MW-17S, MW-17D, and MW-18. The approximate locations of these wells in relationship to Quarry No. 4 are shown on Figures 2-1. (Figure 2-1 also shows the approximate locations of existing upgradient wells MW-11S, MW-11D, MW-12, MW-13S and MW-13D, and upgradient well MW-19S proposed to be installed by the PRP Group.) Wells MW-17S, MW-17D, and MW-18 were sampled in January 1998 and again most recently in May 2001.

Sample Results

During the first round, which was completed as part of the RI in January 1998, the samples obtained from these wells were analyzed for the TCL volatile and semivolatile organic compounds and the TAL Inorganics (i.e., metals and cyanide). During the second round, which was completed as part of the RI in May 2001, the samples were analyzed for the TCL volatile and semivolatile organic compounds, cyanide and a focused list of metals. The samples were analyzed for both total and dissolved metals during both sampling events. The results of the analysis of the groundwater samples are summarized in Table 2-3. As shown in Table 2-3, the results were compared to USEPA MCLs and Act 2 non-residential, used-aquifer, MSCs for groundwater. These standards were used for ease of comparison. However, the work completed as part of the implementation of this Work Plan will be used to support a request to waive the cap and drainage layer requirements for Quarry No. 4 through a demonstration that it is not necessary to limit infiltration into the quarry.

Background Metals in Groundwater

Some of the metals that have been detected in wells downgradient of Quarry No. 4 also occur naturally in the groundwater. A good example of this includes the metals iron and manganese, which occur naturally in groundwater at various concentrations. There are a number of wells currently located upgradient of Quarry No. 4 that have been sampled and would represent background conditions for Quarry No. 4. Therefore, a hydrogeologic evaluation will be completed as part of Task 4 to determine what existing wells should be included in the groundwater monitoring program and what additional wells may need to be installed upgradient of Quarry No. 4 as part of the Demonstration Project.

2.4 Preliminary List of Potential Contaminants of Concern

As will be discussed in Section 4.0, a groundwater sampling program will be implemented at the site to demonstrate that a cap and drainage layer is not necessary to limit infiltration and that a waiver of the cap will not cause or contribute to groundwater degradation as a result of leachate production. In an effort to complete this evaluation, groundwater samples to be collected as part of this program will be analyzed for potential COC. The preliminary list of potential COC,

which is provided below, includes those constituents in the Quarry No. 4 soil samples that exhibited a mean concentration or a maximum concentration, where the maximum concentration was not used to calculate the mean, exceeding its EPA SS SSL or default SSL and/or were detected above MCLs in groundwater samples collected downgradient of the quarry. This list is as follows:

Volatile Organic Compounds

Trichloroethene

Semivolatile Organic Compounds

Benzo(a)anthracene
Benzo(b)fluoranthene
Carbazole

Pesticides/PCBs

None

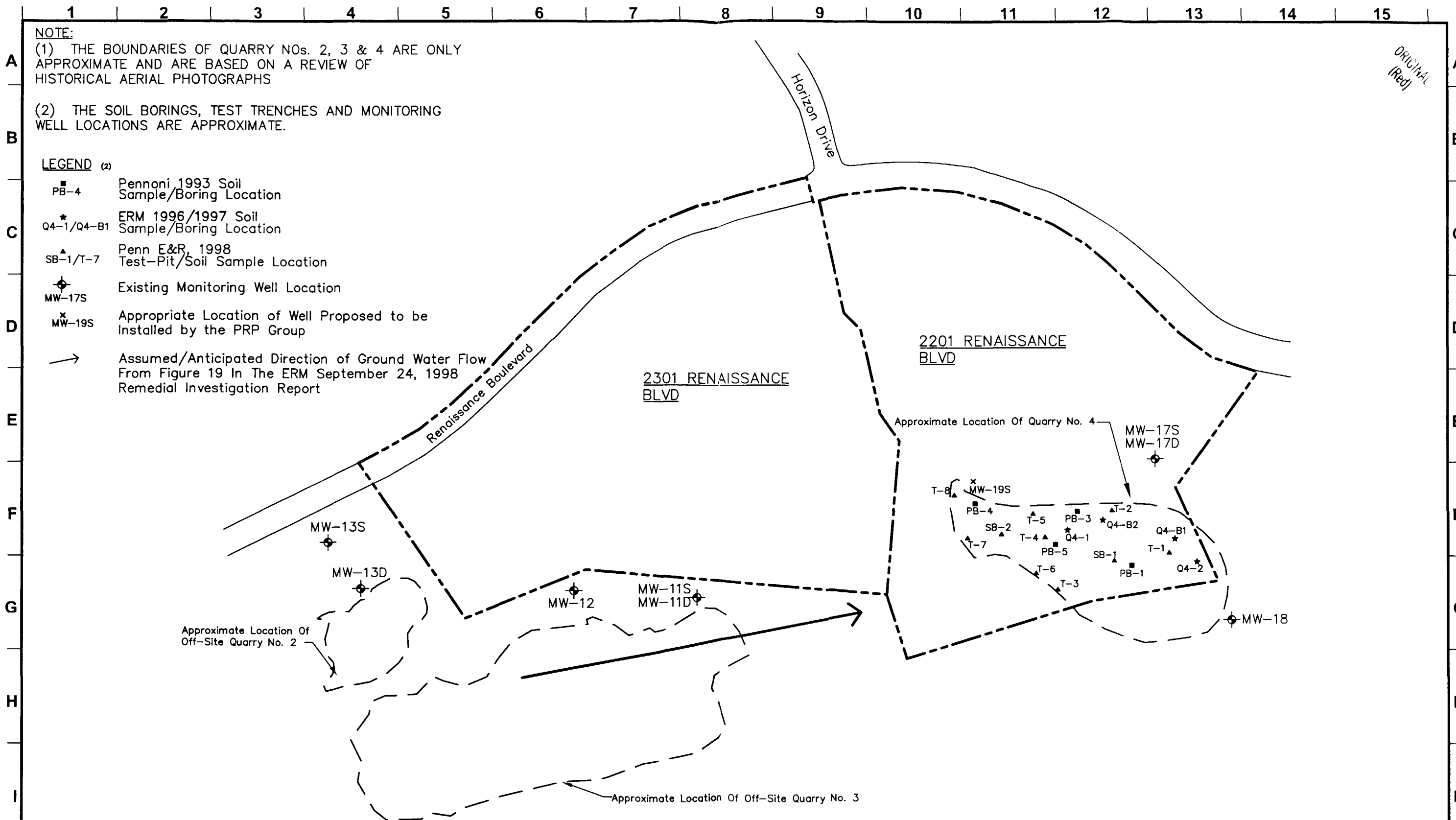
Inorganics

Arsenic
Barium
Chromium
Cobalt
Iron
Lead
Manganese
Mercury
Selenium
Thallium
Vanadium
Cyanide

A background investigation of groundwater conditions is being proposed by the PRP Group as part of Group's work on other portions of the Crater site. Also, as indicated earlier, the PRP Group is proposing to complete a statistical evaluation of the Oxford and ERM background metal results for soils. The results of these analyses will be used to determine which of the metals present in the groundwater and fill material in Quarry No. 4 fall within background levels and, which therefore, will not need to be included in the final COC list to be evaluated as part of the groundwater monitoring program. Additionally, based on the results of the groundwater sampling to be completed by the PRP Group and the hydrogeologic evaluation to be completed by Penn E&R, the preliminary list of potential COC may be further refined.

TABLE 2-1
SUMMARY OF ANALYTICAL RESULTS FOR
SOIL SAMPLES COLLECTED IN QUARRY #4

ANALYTICAL PARAMETERS	SAMPLE DESIGNATION/ANALYTICAL RESULTS ¹⁾																				Mean Concentration ²⁾	Maximum Concentration ³⁾	PADEP NRSG MSC ⁴⁾	USEPA SSSL FOR QUARRY NO. 4 ⁵⁾			
	PENNONI SAMPLES				R/F/S SAMPLES						PENNEER SAMPLES																
	PB-1-27-29	PB-3-10-12	PB-4-35-37	PB-5-50-52	Q4-1 0-0.5	Q4-2 0-0.5	Q4-B-1 18-20	Q4-B-1 78-80	Q4-B2- 6-8	Q4-B2 40-42	SB-1-14-16	SB-1-55-57	SB-2-10-12	SB-2-42-44	Q4T1-2	Q4-T2-2	Q4-T3-2	Q4-T4-2	Q4-T5-2	Q4-T6-15					Q4-T7-13	Q4-T8-2	
Volatile Organics:																											
Methylene Chloride	ND	ND	ND	ND	<0.013	<0.015	0.005B	0.005B	0.003B	0.002B	NA	0.003B	NA	0.003B	0.013B	0.012B	0.012B	0.017B	0.012B	0.012B	0.015B	0.010B	0.005	0.015	0.5	0.019 ⁶⁾	
Acetone	1.1B	0.096B	0.044B	0.025B	<0.013	<0.015	0.53J	<0.012	0.014J	<0.012	NA	<0.013	NA	<0.012	0.03	<0.012	<0.013	<0.012	0.013J	<0.012	0.033	0.038	0.27	1.1	1000	3	
Trichloroethene	ND	ND	ND	ND	<0.013	<0.015	0.066	<0.012	<0.012	<0.012	NA	<0.013	NA	<0.012	<0.013	<0.012	<0.013	<0.012	<0.014	<0.012	<0.014	<0.013	0.036	-	0.5	0.01	
Tetrachloroethene	ND	ND	ND	ND	<0.013	<0.015	0.059	<0.012	<0.012	<0.012	NA	<0.013	NA	<0.012	<0.013	<0.012	<0.013	<0.012	<0.014	<0.012	<0.014	<0.013	0.03	-	0.5	0.03	
Toluene	ND	ND	ND	ND	<0.013	<0.015	0.076	<0.012	<0.012	<0.012	NA	<0.013	NA	<0.012	<0.013	<0.012	<0.013	<0.012	<0.014	<0.012	<0.014	<0.013	0.041	-	100	3	
Ethylbenzene	ND	ND	ND	ND	<0.013	<0.015	0.02	<0.012	<0.012	<0.012	NA	<0.013	NA	<0.012	<0.013	<0.012	<0.013	<0.012	<0.014	<0.012	<0.014	<0.013	0.013	-	70	3	
Xylenes (total)	ND	ND	ND	ND	<0.013	<0.015	0.14	<0.012	<0.012	<0.012	NA	<0.013	NA	<0.012	<0.013	<0.012	<0.013	<0.012	<0.014	<0.012	<0.014	<0.013	0.073	-	1000	42	
Semivolatile Organics:																											
Acenaphthene	ND	1.3	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	<0.38	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	0.23J	<0.43	<0.60	1.3	4700	NSA	
Anthracene	0.51	1	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	0.059J	<0.440	0.038J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	0.043J	0.078J	<0.43	0.14	1	350	470 ⁷⁾	
Benzo(a)anthracene	0.61	2.8	ND	ND	0.098J	0.110J	<0.410	<0.410	0.110J	<0.810	0.22J	<0.440	0.10J	<0.4	0.052J	<0.41	0.047J	<0.38	<0.46	0.14J	0.51	0.12J	0.26	2.8	320	1	
Benzo(b)fluoranthene	0.44	2.1	ND	ND	0.150J	0.270J	<0.410	<0.410	0.110J	<0.810	0.26J	<0.440	0.11J	<0.4	0.082J	0.056J	0.062J	0.066J	<0.46	0.14J	1.2	0.28J	0.26	2.1	170	2	
Benzo(k)fluoranthene	0.39	1.8	ND	ND	0.060J	0.057J	<0.410	<0.410	0.096J	<0.810	0.068J	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	0.34J	0.063J	0.25	1.8	610	20	
Benzo(g,h,i)perylene	0.41	1.5	ND	ND	0.064J	0.100J	<0.410	<0.410	<1.6	<0.810	0.14J	<0.440	0.052J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.46J	1	0.20J	0.60	1.5	180	NSA	
Benzo(a)pyrene	0.53	0.24	ND	ND	0.120J	0.093J	<0.410	<0.410	0.099J	<0.810	0.13J	<0.440	0.059J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	0.059J	0.43	0.16J	0.25	0.43	46	1	
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	<0.440	<0.480	0.027J	<0.410	0.280B	0.140B	0.11J	<0.440	0.23J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	0.29JB	<0.43	0.30	140	11		
Carbazole	ND	0.71	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	0.37J	<0.440	0.13J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	0.056J	<0.43	0.25	0.71	83	0.47	
Chrysene	0.6	3.1	ND	ND	0.090J	0.220J	<0.410	<0.410	0.140J	<0.810	<0.38	<0.440	0.13J	<0.4	0.090J	<0.41	0.11J	0.071J	<0.38	0.23J	0.57	0.18J	0.27	3.1	60		
Dibenz(a,h)anthracene	ND	0.99	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	0.24J	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	0.34J	0.052J	0.23	0.99	160	1.4 ⁸⁾	
Dibenzofuran	0.38	0.76	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	0.048J	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	0.13	0.76	NSA	7.7 ⁹⁾	
Di-n-butylphthalate	ND	ND	ND	ND	<0.440	<0.480	0.190J	<0.410J	<1.6	<0.810	0.37J	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	0.30	-	4100	100	
Di-n-octylphthalate	ND	ND	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	0.002J	<0.38	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	0.80	-	10000	2.4 x 10 ⁶⁾	
Fluoranthene	1.6	9	ND	ND	0.140J	0.290J	<0.410	<0.410J	0.160J	<0.810	0.37J	<0.440	0.25J	0.072J	0.12J	0.059J	0.12J	0.068J	<0.46	0.34J	0.47	0.14J	0.28	9	3200	1,200	
Fluorene	0.54	1.2	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	<0.38	<0.440	<0.36	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	<0.60	1.2	3800	140 ¹⁰⁾	
Indeno(1,2,3-cd)pyrene	ND	1.5	ND	ND	0.074J	0.097J	<0.410	<0.410	0.090J	<0.810	0.14J	<0.440	0.038J	<0.4	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	1.2	0.15J	0.45	1.5	28000	13 ¹¹⁾	
2-Methylnaphthalene	ND	0.4	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	<0.38	<0.440	<0.36	<0.4	0.043J	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	<0.60	0.4	8000	22 ¹²⁾	
4-Methylphenol	ND	ND	ND	ND	<0.440	<0.480	<0.410	<0.410	<1.6	<0.810	<0.38	<0.440	<0.36	<0.4	0.042J	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	0.19	-	NSA	NSA	
Naphthalene	0.71	0.48	ND	ND	<0.440	<0.480	0.059J	<0.410J	<1.6	<0.810	<0.38	<0.440	<0.36	<0.4	0.046J	<0.42	<0.41	<0.42	<0.38	<0.46	<0.4	<0.45	<0.43	0.13	0.71	25	15
Phenanthrene	2.1	12	ND	ND	0.053J	0.120J	<0.410	<0.410J	0.110J	<0.810	0.24J	<0.440	0.16J	0.051J	0.11J	<0.41	0.079J	0.045J	<0.46	0.21J	0.16J	0.047J	0.26	12	10000	260	
Pyrene	1.6	10	ND	ND	0.140J	0.300J	<0.410	<0.410	0.150J	<0.810	0.35J	<0.440	0.28J	0.074J	0.095J	0.056J	0.15J	0.059J	<0.46	0.36J	0.52	0.15J	0.27	10	2200	1,300	
Pesticide/PCBs:																											
Gamma-BHC(Lindane)	<0.0017	<0.0021	<0.0017	<0.0021	NA	NA	<0.0042	<0.0042	<0.0012	<0.0012	0.00026	<0.0023	<0.0019	<0.002	NA	NA	NA	NA	NA	NA	NA	NA	0.0007	-	0.072	0.0043 ¹³⁾	
Dieldrin	<0.0033	<0.004	<0.0033	<0.0042	NA	NA	<0.0081	<0.0082	<0.004	<0.004	0.00033	<0.0044	<0.0036	<0.004	NA	NA	NA	NA	NA	NA	NA	NA	0.0013	-	0.44	0.0022 ¹⁴⁾	
4,4'-DDE	<0.0033	<0.004	<0.0033	<0.0042	NA	NA	<0.0081	<0.0082	<0.004	<0.004	0.01	<0.0044	<0.0036	<0.004	NA	NA	NA	NA	NA	NA	NA	NA	0.0061	-	170	35 ¹⁵⁾	
Endrin	<0.0033	<0.004	<0.0033	<0.0042	NA	NA	<0.0081	<0.0082	<0.004	<0.004	0.0013	<0.0044	<0.0036	<0.004													



ORIGINAL
(Red)

FORM REVISED 26-MAR-01 LEGEND:	0 1 2 FRACTIONAL 0 1 2 DECIMAL GRAPHIC SCALE		NORTH	 Penn E&R Environmental & Remediation, Inc. 2755 BERRY ROAD, HATFIELD, PENNSYLVANIA, 19440 - 215.937.9000 Fax 215.922.8575 Copyright 2001 Penn Environmental & Remediation, Inc. All RIGHTS RESERVED. Neither all, nor any part of this document may be amended, reproduced, copied or used in any form or manner except pursuant to contract with or with the specific written permission of Penn Environmental & Remediation, Inc.	PROJECT: 4236 SCALE: 1"=215' BY: JMD REVIEWED:	FIGURE 2-1 SITE MAP FOR 2201/2301 RENAISSANCE BOULEVARD SHOWING QUARRY NO.4, PERTINENT ON-SITE & OFF-SITE FEATURES AND PREVIOUS/EXISTING SOIL SAMPLE AND MONITORING WELL LOCATIONS DATE: 26-Sep-01		PENN E&R DRAWING NO.: 4236-056 FIGURE NO.: REV:

ATTACHMENT 2A

Original
Rec'd

**LITHOLOGIC LOG FOR SOIL BORING SB-1
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-0.5	0	Brown silt, little sand, no smell.
0.5-1.5	0	Brown clayey silt, no smell.
1.5-2	0	Concrete fill, no smell.
2-3	0	Coarse, dark brown, sand, wet, no smell.
3-3.5	0	Dark brown, clayey silt, no smell.
3.5-4	**	Brown clayey silt with limestone, no smell.
4-5	**	Same as above, no limestone fragments, no smell.
5-6	0	Gray mortar & brick fill with some brown clayey silt & wood, no smell.
6-8	**	No recovery.
8-9.5	0	White stone & gray, sandy fill, no smell.
9.5-10	**	Black silty fill, limestone fragments, no smell.
10-12	0	No recovery.
12-14	0	Very little recovery. Wood & gray shist, no smell.
14-15	0	Light brown clayey silt with shist & limestone fragments, no smell.
15-16	25.4	Wood & shist fragments, very little silt, slight creosote smell, black stained soil.
16-20	0	Black silt, some clay, wood & root fragments.
20-22	**	No recovery.
22-24	0	Very little recovery. Brown silty clay with coarse sand with quartz & shist fragments.
24-25	4.0	Same as above but with wood & root matter. Slight creosote odor.
25-26.5	**	Very soft & wet, brown, clayey silt. No smell.
26.5-27	0	Black wet clayey silt with some coal. No smell.
27-30	0	Tan to gray silt, little clay, no smell.
30-31	**	Brown clay with some silt & limestone fragments. No smell, wet.
31-32	0	Brown clay, little silt and sand, dryer with plenty of limestone, little root material, no smell.
33-35	0	Brown clay with little silt, some limestone fragments, very little root, no smell.
35-37	1.7	Brown to redish brown clay with little silt, limestone & quartz fragments, soft, wet, no smell.
40-41	0	Same as above, no smell.
41-42	**	Brown clay with abundant limestone fragments & little quartz. Clay was mottled slightly and very little root material.
45-46	0	Brown silty clay, no fragments, no smell.
46-47	11.0	Gray silty clay with a creosote smell, moist to wet.
47-49	40.0	Same as above with a little stronger smell, some roots.
49-51	1.5 - 6.7	Same as above, slight creosote or sweet smell.
51-53	9.9	Same as above with a sweet creosote smell & few roots that are very fine. Sample is wet.
53-55	17.0	Same as above.
55-56.5	80.0	Gray to tan silty clay, with a sweet creosote smell.
56.5-57	40.0	Black coarse sand, same smell.
57-58.5	5.0	Black coarse to medium sand with little silty clay, very wet. Slight sweet creosote smell.
58.5-59	0	Brown to light tan, silty clay, very, very slight smell, not as wet.
59-60	8.0	Black medium to coarse sand, creosote smell.
60-61	10.0	Gray silty clay with black streaks, sweet creosote smell.
61-63	0	Brown silty clay with some sand, no smell.
65-66	0	Brown, gray clay, some silt, no smell, wet.
66-67	0	Brown, light, dry weathered shist with some silt, no smell.
69	0	Spoon refusal.

Notes:

fbgs - Feet below the ground surface
 PID - Photoionization detector
 ppm - Parts per million
 ** - No PID measurement obtained

Original
Bore

**LITHOLOGIC LOG FOR SOIL BORING SB-2
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-0.5	0	Dark brown silt, no smell.
0.5-1.5	**	Brown clayey silt fill with roots & rocks, no smell.
1.5-2	0	Black silt fill with organic smell, dry.
2-4	0	Black silt fill with rounded gravel, slag and coal ash, no smell.
4-6	**	Same as above.
6-8	0	Same as above but with more rounded stones, no smell.
8-10	0	Black silt fill with coal ash, or very small fragments of coal, slag and few rounded stones, no smell.
10-12	0	Same as above with some brick fragments, no smell, moist.
12-14	**	Same as above but wetter.
14-15	**	Same as above.
15-16	**	Same as above but with more coal fragments & some limestone fragments, no smell.
20-22	**	Same as above.
25-26	0	Same as above, still wet, no smell.
26-27	0	Silty clay, dark gray with some concrete, no smell, wet.
30-32	0	Dark gray silty clay with some rounded stones, some root material, no smell.
35-37	8	Tan-gray silty clay with some black streaks, no smell.
40-42	10	Tan-gray wet clayey silt, few black streaks, slight creosote smell.
42-43	15	Brown clayey silt with some shist fragments, slight ammonia smell.
43-44	10	Brown & gray weathered shist, very slight ammonia smell.
44-46	7.5	Brown & gray weathered shist, some brown clayey silt, no smell.
46-48	**	Brown clayey silt with shist & limestone fragments.
50-51.5	**	Brown clayey silt with shist & limestone fragments.
51.5-52	0	Limestone chunks & fragments, no smell.
55-57	15	Brown silt, little shist, limestone fragments. The top of spoon has clayey silt, gray tan with slight ammonia odor.
60-62	0	Brown silt, little clay with darker brown silt, some shist & limestone fragments, no smell.
65-67	0	Brown clayey silt & limestone, no smell, very wet.
70-71	0	Wet, light brown silty clay with limestone fragments, no smell.
71-72	0	Light brown with red streaks, silt, some clay, very tight, no smell.
75-76	0	Dark brown with orange streaks, clayey silt, no smell.
76-76.5	**	Light brown to orange white clayey silt.
76.5-77	0	White with brown and orange streaks, weathered shist, no smell.
80-82	0	Dark brown silt with white streaks of clayey silt or weathered shist, no smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

0-11.5-15
19.4

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T1
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-0.5	**	Black topsoil mixed with brick or stone.
0.5-2	**	Brown orange clayey silt with shist, bricks & limestone fragments.
2-5	0	Orange silt fill with brick, large limestone fragments, some shist rocks. metal, railroad tie at 5' & vinyl seat cover. Some gray clayey silt with black organic streaks, no smell.
5-9.5	0	Tan-brown silty fill with many bricks and cinderblocks mixed with wood, shist & limestone, no smell.
9.5-11.5	0	Black wood with possible burnt smell, possible tar paper mixed with black wood.
11.5-15	0	Gray & brown silty clay fill with bricks, wood, cinderblock, shist & limestone rocks, no smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

05/10/11
RWS

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T2
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-0.5	0	Gray brown silty topsoil with some limestone bolders.
0.5-1.5	0	Orange clayey silt, no smell.
1.5-5.5	0	Dark brown silt with slag, baseball sized rounded gravel, few bricks, no smell, very hard.
5.5-9.5	**	Orange clayey silt with tire, brick and limestone, some to very little slag.
9.5-11	**	Black organic material, rotten wood with silt fill, some bricks.
11-15	0	Tan-orange clayey silt with root material, no smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T3
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-3	**	Black silt with little slag and little gravel.
3-5	0	Tan-gray silty clay with some brown clayey silt, few gravel, little root.
5-7	0	Brown sandy-silt with small quartz limestone gravel.
7-8	**	Same as above with some larger rock pieces.
8-12	0	Gray to tan silt and clay fill with roots, wood, brick, cinderblock, little black silt, no smell.
12-15	0	Brown silt with some brown clumps of clay, cinderblocks, sandstone fragments, slate fragments at 15', orange clayey silt. No smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T4
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-7.5	0	Black silt material with sand or metal sand. Same as Q4-T3. No smell. Roots and cut up tree trunks also mixed in.
7.5-15	0	Gray-white sand with some silt. Trace of red sand, rounded quartz or sandstone, white silt pockets and weathered sandstone, no smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T6
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-15	0-48	Black silty ash-like fill. The material was clumped together in spots & contained rounded gravel. Possible slight petroleum smell.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T7
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-2	**	Brown silt and clay with tubes, concrete and plastic.
2-5.5	0	Orange-brown silty clay with little slag, some roots, no smell.
5.5-15	0-3	Brown-gray clayey silt with many roots.

Notes:

fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

**LITHOLOGIC LOG FOR TEST TRENCH Q4-T8
INSTALLED IN QUARRY NO. 4**

SAMPLE COLLECTION DEPTH (fbgs)	PID READINGS (ppm)	COMMENTS
0-1	**	Brown silty topsoil with concrete and tree trunk.
1-3	**	Gray silty clay with concrete and tree limbs - a piece of 4" steel pipe was encountered at 2' BGS.
3-10	**	Gray-brown clayey silt with many roots, water at 7' BGS.

Notes:

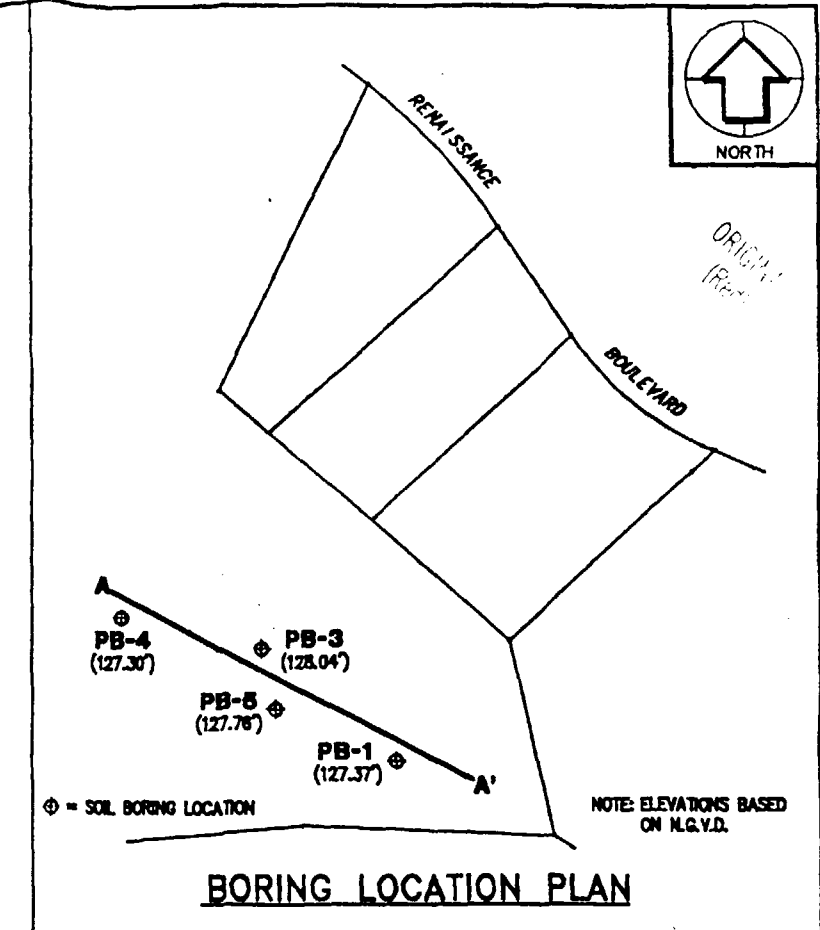
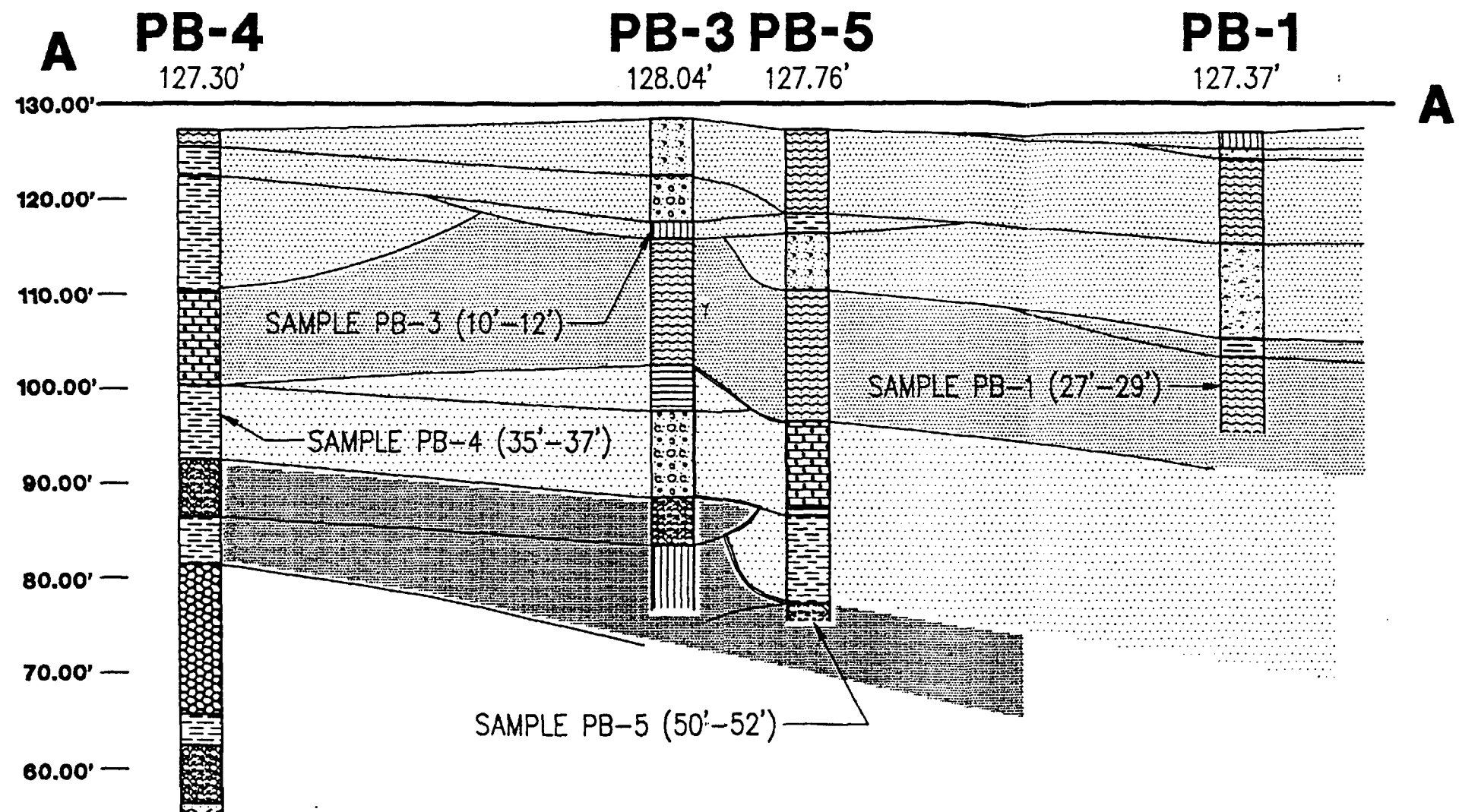
fbgs - Feet below the ground surface

PID - Photoionization detector

ppm - Parts per million

** - No PID measurement obtained

CROSS-SECTION A-A'



NOTE: VERTICAL SCALE EXAGGERATED 3X



Pennoni Associates Inc.
1600 Callowhill Street
Philadelphia, PA 19130

DRAWN BY:
DJF
CHECKED BY:
WPF
JOB No.
PSQP-93B1.001.01

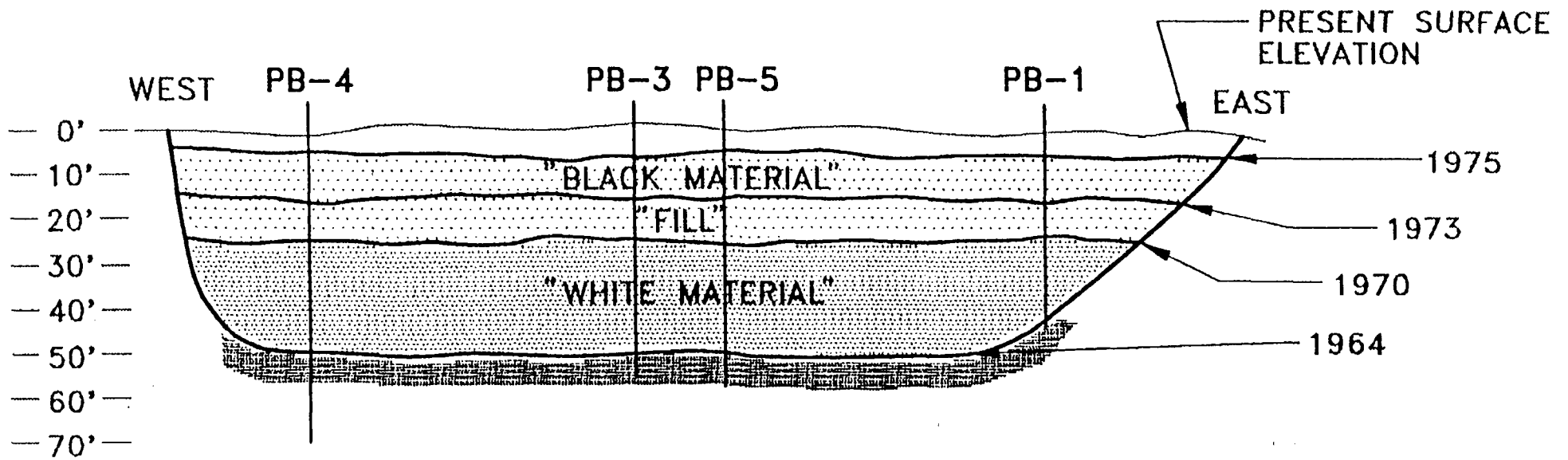
SCALE:
1"=50'

DATE:
10-13-93

RENAISSANCE SOUTH
UPPER MERION, PA.

INTERPRETATION OF STRATIGRAPHY OF DEPRESSION AREA

DEPRESSION



Pennoni Associates Inc.
1800 Callowhill Street
Philadelphia, PA 19130

DRAWN BY:
DJF

CHECKED BY:
WPF

JOB No.
PSQP-93B1.001.01

SCALE:
NONE

DATE:
10-15-93

RENAISSANCE SOUTH
UPPER MERION

CROSS SECTION OF HISTORICAL FILLING

ORIGINAL
Red

Environmental Resources Management

Q4-B1

WO No: H4902.10.01Date Drilled 8/21-8/22/97Project: RI/FS

Owner

Crater Resources-PRP GroupLocation Up. Merion Twp., Pa.

Boring Depth (ft)

80Dia (in) 8.75 inches

Northing

NA

Surface Elev.

NA

ft msl

Easting

NA

Casing Elev.

NA

ft msl

Screen Type

NA

Length (ft)

NADia (in) NA

Slot Size (in)

NA

Stabilized DTW (ft)

-13 Ft.

Casing Type

NA

Length (ft)

NADia (in) NAMethod: Hollow Stem Auger


Driller

Tony PressimoneGeologist B. Gordon

Location Sketch Map

Drilling Company

Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval(ft BGS)	Sample Description/Classification
128	0		13/24	3,12,60/2"	0-3	0-2	(0-6") SANDY-SILT, dark brown, organic rich, with roots, wet.
			18/24	10,10,7,17	20	2-4	(6"-42") CLAYEY-SILT, light orange to orange, with dark gray to black organic rich silty-sand, trace limestone, trace asphalt and fill material, dry.
			19/24	22,14,18,22	3	4-6	CLAYEY-SILT, medium orange-brown, brittle, with fill rocks
123	5		3	60/3"	5	6-8	(limestone, schist, quartz, and possibly coal), dry.
			17/24	4,13,12,12	20-30	8-10	SILT, dark brown to black, soft.
			18/24	10,6,6,9	120	10-12	CLAYEY-SILT, as above.
118	10		20/24	5,5,5,7	2-3	12-14	CLAYEY-SILT, as above.
			22/24	5,6,5,5	0	14-16	SILTY-CLAY, medium brown, trace sand, with some limestone fragments, water at 13 feet.
			24/24	6,8,6,7	15-30	16-18	SILTY-CLAY, as above.
113	15		18/24	9,8,8,8	300-350+	18-20	SILTY-CLAY, as above, with black stains.
			24/24	2,7,5,6	0	20-22	SILTY-CLAY, medium brown, trace sand, some black stains, moist to wet, creosote odor noticed. Sample collected 18-20'.
108	20						SILTY-CLAY, as above, with black stains.

ORIGINAL
(Ref)

Environmental Resources Management

Q4-B1

WO No: H4902.10.01 Date Drilled 8/21-8/22/97
 Project: RI/FS Owner Crater Resources-PRP Group
 Location Up. Merion Twp., Pa. Boring Depth (ft) 80 Dia (in) 8.75 inches
 Northing NA Surface Elev. NA 128 ft msl
 Easting NA Casing Elev. NA ft msl
 Screen Type NA Length (ft) NA Dia (in) NA
 Slot Size (in) NA Stabilized DTW (ft) -13 Ft.
 Casing Type NA Length (ft) NA Dia (in) NA
 Method: Hollow Stem Auger Driller Tony Pressimone Geologist B. Gordon
 Drilling Company Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Location Sketch Map

Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval(ft BGS)	Sample Description/Classification
			24/24	7,6,5,6	0.5-1	22-24	SILTY CLAY, as above.
			24/24	5,8,6,8	0	24-26	SILTY-CLAY, sandy, medium brown, with limestone
103	25		24/24	7,10,11,12	0	26-28	fragments, trace red sandstone, trace plant fragments. SILTY-CLAY, as above.
			24/24	10,7,8,7	0	28-30	SILTY-CLAY, as above, with abundant limestone fragments.
98	30		24/24	5,8,8,10	50-100	30-32	SILTY-CLAY, medium-brown, sandy, soft, wet. Creosote-odor noticed.
			24/24	7,11,15,16	1-2	32-34	SILTY-CLAY, as above.
			24/24	6,8,11,9	0.5	34-36	SILTY-CLAY, as above.
93	35		24/24	9,9,10,10	1	36-38	SILTY-CLAY, as above.
			24/24	11,11,13,15	0	38-40	SILTY-CLAY, sandy, medium brown to gray, with roots and twigs, limestone fragments.
88	40		22/24	3,10,10,13	0	40-42	SILTY-CLAY, as above.
			20/24	11,13,13,13	0	42-44	SILTY-CLAY, as above.

Environmental Resources Management

Q4-B1

WO No: H4902.10.01 Date Drilled 8/21-8/22/97
 Project: RI/FS Owner Crater Resources-PRP Group
 Location Up. Merion Twp., Pa. Boring Depth (ft) 80 Dia (in) 8.75 inches
 Northing NA Surface Elev. NA 128 ft msl
 Easting NA Casing Elev. NA ft msl
 Screen Type NA Length (ft) NA Dia (in) NA
 Slot Size (in) NA Stabilized DTW (ft) -13 Ft.
 Casing Type NA Length (ft) NA Dia (in) NA
 Method: Hollow Stem Auger Driller Tony Pressimone Geologist B. Gordon
 Drilling Company Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Location Sketch Map

Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval(ft BGS)	Sample Description/Classification
			8/24	15,17,16,22	0	44-46	SILTY-CLAY, dark gray-brown, with roots, limestone fragments.
83	45		20/24	24,23,25,29	0	46-48	SILTY-CLAY, as above.
			24/24	18,23,23,23	0	48-50	SILTY-CLAY, dark grey-brown, micaceous, with limestone fragments, and roots.
78	50		21/24	9,11,10,12	0	50-52	SILTY-CLAY, medium brown, micaceous, limestone fragments, with thin stringers of grey and black sand.
			20/24	9,9,17,18	0	52-54	SILTY-CLAY, as above, grey to black sand stringers present.
			24/24	6,6,13,13	0.2	54-56	SILTY-CLAY, as above, black sand stringers present.
73	55		24/24	11,12,18,19	0	56-58	SILTY-CLAY, as above, black sandy stringers present.
			24/24	11,13,12,12	0	58-60	SILTY-CLAY, as above, thin black and grey layers present.
68	60		24/24	11,14,12,16	0	60-62	SILTY-CLAY, medium-brown to medium-gray, mottled, white and black sand stringers.
			24/24	10,10,13,16	0	62-64	SILTY-CLAY, as above, with schist fragments.
			24/24	6,6,8,10	0.3	64-66	SILTY-CLAY, light tan, mottled, with schist fragments, with orange brown silty clay. (At about 65 feet a 3" flat piece of
63	65						

Environmental Resources Management

Q4-B1

WO No: H4902.10.01 Date Drilled 8/21-8/22/97
 Project: RI/FS Owner Crater Resources-PRP Group
 Location Up. Merion Twp, Pa. Boring Depth (ft) 80 Dia (in) 8.75 inches
 Northing NA Surface Elev. NA 128 ft msl
 Easting NA Casing Elev. NA ft msl
 Screen Type NA Length (ft) NA Dia (in) NA
 Slot Size (in) NA Stabilized DTW (ft) ~13 Ft.
 Casing Type NA Length (ft) NA Dia (in) NA
 Method: Hollow Stem Auger Driller Tony Pressimone Geologist B. Gordon
 Drilling Company Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Location Sketch Map

Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval(ft BGS)	Sample Description/Classification
			24/24	8,13,18,23	0.2	66-68	black material was present, creosote-odor noticed).
			24/24	14,23,35,45	0	68-70	SILTY-CLAY, as above.
							SILTY-CLAY, gray to brown, mottled, abundant weathered schist, harder then above.
58	70		24/24	18,35,44,71	0	70-72	SILTY-CLAY, gray to brown, mottled, abundant weathered schist, black sand.
			24/24	15,19,31,49	0	72-74	SILTY-CLAY, gray to brown, mottled, abundant rock fragments (red sandstone, schist, and quartz pebbles), w/ thin black layers.
			24/24	14,21,17,15	0	74-76	SILTY-CLAY, as above.
53	75		24/24	21,18,35,41	0	76-78	SILTY-CLAY, as above.
			24/24	25,24,26,30	2	78-80	SILTY-CLAY, gray to brown, mottled, with white and black layers and inclusions, creosote-odor noticed in black layers.
-80	80						Sample collected 78-80'.

Environmental Resources Management, Inc.

Q4-B2

WO No: H4902.10.01 Date Drilled 22 Sep 97
 Project: R/FS Owner Crater Resources-PRP Group
 Location Up. Merion Twp., Pa. Boring Depth (ft) 42 Dia (in) 8.75 inches
 Northing NA Surface Elev. NA 128 ft msl
 Easting NA Casing Elev. NA NA ft msl
 Screen Type NA Length (ft) NA Dia (in) NA
 Slot Size (in) NA Stabilized DTW (ft) -13 Ft. 8/22/97
 Casing Type NA Length (ft) NA Dia (in) NA
 Method: Hollow Stem Auger Driller Tony Pressimone Geologist B. Gordon
 Drilling Company Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Location Sketch Map


Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval (ft BGS)	Sample Description/Classification
128	0		24/24	6,24,50,100/5"	0	0-2	(0-19") SANDY-SILT, dark grey to black, dry, with organic material
			0/24	50/0	0	2-4	(19-24") SILTY CLAY, red-brown, with abundant rock frags. (fill). No Recovery
			9/10	42,100/4"	0	4-6	SANDY SILT, dark brown to black, dry, brittle with fill material,
123	5		22/24	7,13,14,17	40-45	6-8	(concrete and limestone fragments). SANDY SILT, dark brown to black, dry, brittle with fill material,
			1/24	13,18,26,100/4"	0	8-10	(slag and concrete fragments). SILTY CLAY, dark grey, with fill material (slag and cinders).
118	10		13/24	1,12,14,18	0	10-12	CLAYEY-SILT, medium brown, with fill material
			17/24	24,20,24,18	0	12-14	(concrete, cinders and slag). SANDY SILT, dark brown to black, gravelly, with fill material,
			16/24	19,10,15,7	0	14-16	(concrete and slag fragments, bricks, rotting wood).. SILTY SAND, dark grey, moist, trace fill (cinders and slag).
113	15		0/24	1,3,1,3	0	16-18	No Recovery
			0/24	3,3,20,19	0	18-20	No Recovery, trace decomposed wood.
108	20		0/24	8,100/5"	0	20-22	No Recovery, spoon wet.
			4/5	100/5"	0	22-24	SILTY CLAY, dark grey, extremely soft and wet,
			13/26	10,10,18,12	0	24-26	micaceous, soupy texture, slight odor (sewage-like). SILTY-CLAY, light tan to light grey, micaceous, possible

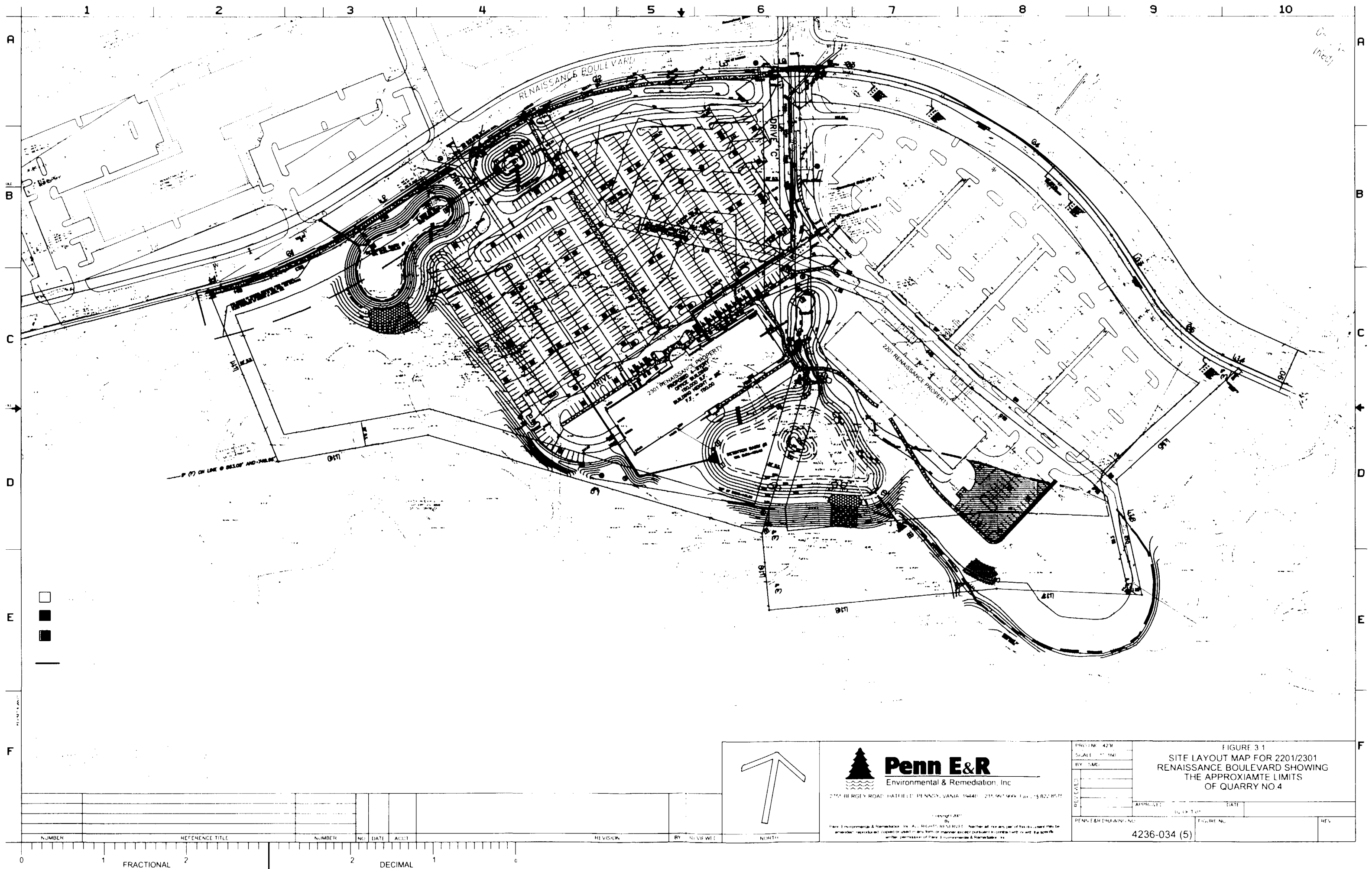
Environmental Resources Management, Inc.

Q4-B2

WO No: H4902.10.01 Date Drilled 22 Sep 97
 Project: RI/FS Owner Crater Resources-PRP Group
 Location Up. Merion Twp, Pa. Boring Depth (ft) 42 Dia (in) 8.75 inches
 Northing NA Surface Elev. NA 128 ft msl
 Easting NA Casing Elev. NA NA ft msl
 Screen Type NA Length (ft) NA Dia (in) NA
 Slot Size (in) NA Stabilized DTW (ft) -13 Ft. 8/22/97
 Casing Type NA Length (ft) NA Dia (in) NA
 Method: Hollow Stem Auger Driller Tony Pressimone Geologist B. Gordon
 Drilling Company Aquifer Drilling & Testing Mid - Atlantic, Inc. Trenton, N. Jersey

Location Sketch Map

Elevation (feet MSL)	Depth (feet BGS)	Graphic Log	Recovery (0-24")	Blow Counts (per 0.5 ft)	OVA Readings (ppm)	Sample Interval (ft BGS)	Sample Description/Classification
103	25		11/24	6,6,14,18	0	26-28	SCHIST SAPROLITE, with quartz stringers.
			24/24	6,6,12,22	0	28-30	SILTY-CLAY, possible SCHIST SAPROLITE, containing fill material, string and wire.
							SILTY-CLAY, SCHIST SAPROLITE, as above. No fill material.
98	30		13/24	8,18,20,23	0	30-32	SILTY-CLAY, SCHIST SAPROLITE, medium-brown, soft, wet.
			24/24	14,18,22,24	0	32-34	Trace black SILTY CLAY, soupy texture.
			16/24	13,14,24,27	0	34-36	SILTY-CLAY, SCHIST SAPROLITE, as above.
93	35						SILTY-CLAY, SCHIST SAPROLITE, light tan to light grey.
			20/24	21,25,29,21	0	36-38	firmer, dry.
			16/24	28,28,41,45	0	38-40	SILTY-CLAY, SCHIST SAPROLITE, as above.
88	40		19/24	16,25,28,30	0	40-42	SILTY-CLAY, SCHIST SAPROLITE, as above.
							Total Depth = 42' bgs.
							Lab samples taken from 6-8 ft bgs and 40-42 ft bgs.



4.0 QUARRY NO. 4 DEMONSTRATION PROJECT

This Section of the RDWP presents and describes the additional data gathering and evaluation activities that will be implemented to support a request to waive the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry. This section incorporates the tasks required by EPA, in its April 9, 2001 letter to Penn E&R, outlining the additional data needs for the Demonstration Project. The activities proposed for implementation have been divided into the following four separate tasks:

- Task 1 - Data Evaluation
- Task 2 - Evaluation of Soils Used as Cover at Quarry No. 4
- Task 3 - Groundwater Monitoring Program
- Task 4 - Reporting

The activities to be implemented as part of these tasks are discussed below.

4.1 Task 1 - Data Evaluation

As part of the Task 1 activities, Liberty will perform a detailed analysis of the hydrogeologic setting of Quarry No. 4 and the immediate surrounding areas, and will complete an evaluation of background soil conditions. The results of these activities will be included in the Interim Remedial Design Report to be developed as part of the Task 4 activities.

Hydrogeologic Evaluation

The primary objectives of the hydrogeologic evaluation will be to confirm the direction of groundwater flow and evaluate shallow and deep groundwater flow beneath Quarry No. 4. The information generated during the Task 1 activities will be used to finalize the locations of the wells to be installed during the Task 3 activities, the construction of these wells and their completion depths.

As part of this analysis, Liberty will obtain depth-to-water level measurements from existing wells located downgradient and in the immediate vicinity of Quarry No. 4. These wells include MW-11S, MW-11D, MW-12, MW-13S, MW-13D, MW-15S, MW-15D, MW-16S, MW-16D, MW-17S, MW-17D and MW-18. Depth-to-water level measurements will also be collected from well MS-19S, which the PRP Group has proposed to install just northeast of Quarry No. 4 (see Figure 2-1). Using these measurements, along with measurements previously collected from these wells, Liberty will develop groundwater contour maps for the shallow and deep groundwater systems. Liberty will also develop hydrogeologic cross-sections for the Quarry No. 4 area. These cross-sections will be developed using lithologic and hydrogeologic information obtained from the existing wells installed upgradient and downgradient of Quarry No. 4 and the soil borings and test trenches previously installed in the quarry. The cross-sections will show existing grade including the soil and other structures placed on top of the quarry, the surface of the filled quarry, the soil used to fill the quarry, the inferred bottom of the quarry, and the hydraulic head values for the screened intervals included in the sections. Penn E&R will also

develop contour maps that show horizontal and vertical groundwater flow gradients and directions.

Liberty will also compile and review available geologic/hydrogeologic reports that may be available for this portion of Upper Merion Township. This review will also include the geologic and hydrogeologic information included in the Remedial Investigation report developed for the Crater site.

The results of this evaluation will be included in the Interim Remedial Design Report (IRDR) to be developed as part of the Task 4 activities. The IRDR will include a detailed discussion of the geologic and hydrogeologic setting of Quarry No. 4, contour maps that will show and confirm the direction of groundwater flow, and hydrogeologic cross-sections of the Quarry No. 4 area. The IRDR will also include a discussion of what, if any, vertical flow components exist in this area and an estimation of total flow through the quarry (i.e., surface water and groundwater). Also, the IRDR will include a list of those existing wells that are located upgradient of Quarry No. 4 (i.e., MW-11S, MW-11D, MW-12, MW-13S and MW-13D), and those to be installed by the PRP Group as part of their investigation of background groundwater conditions, which may be incorporated into the groundwater monitoring program. Additionally, the IRIR will include the proposed number and final locations of new wells to be installed, both upgradient and downgradient of Quarry No. 4, and their completion depths.

Evaluating/Establishing Background Concentrations for Metals in Soils

As discussed in Section 2.0, in December 1999, Environmental Resources Management (ERM) collected six soil samples as part of the Crater RI to establish background concentrations for metals in soils. Additionally, in December 2000, Oxford Engineers and Consultants, Inc. (Oxford) collected twelve soil samples to establish background concentrations for specific metals in soils as part of the implementation of remedial activities on other portions of the Crater site. The two data sets were generally consistent with regard to the concentration range over which the metals were detected. The background concentrations presented by Oxford were approved by the USEPA for use in other portions of the Crater site.

As discussed in Section 2.0, the mean/maximum concentrations for some metals detected in Quarry No. 4 exceeded their EPA SS SSLs. The mean/maximum concentrations and SS SSLs for some of these metals (i.e., aluminum, arsenic, chromium, and manganese) fall within the Oxford and ERM background concentration ranges discussed above and previously summarized in Table 2-2. The PRP Group has proposed to complete a statistical evaluation of the Oxford and ERM background metal results. Therefore, as part of Task 1 activities, Penn E&R proposes to evaluate and use the results of the PRP Group's statistical evaluation to determine what metals detected in Quarry No. 4 fall within background levels. Those metals that are determined to fall within background levels will be eliminated from the list of COC to be included in the groundwater-sampling program proposed as part of this Work Plan. The results of this analysis will be included in the IRDR to be developed as part of Task 4.

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Evaluating/Establishing Background Concentrations for Metals in Groundwater

A background investigation of groundwater conditions is being proposed by the PRP Group for work that the Group is completing on other portions of the Crater site. As part of the Task 1 activities, Liberty will evaluate the results of this background assessment. The results of this evaluation will be used to determine what metals present in the ground water fall within background concentrations and, which therefore, will not need to be included in the final COC list to be evaluated as part of the groundwater monitoring program. The results of this analysis will be included in the IRDR to be developed as part of Task 4.

4.2 Task 2 - Evaluation of Soils Used as Cover at Quarry No. 4

As discussed in Section 3.0, a majority of the surface of Quarry No. 4 was covered with 2 or more feet of soil as part of the development of the 2201 Renaissance Boulevard property. A majority of this soil was obtained from the northern portions of the 2201 property, which were cut to required construction grades, and used to fill the southern portions of the site including areas over Quarry No. 4. Although there is no evidence that these soils were impacted in any way by site contaminants, the USEPA, in its April 9, 2001 comment letter, requested that Liberty evaluate these soils to ensure that their presence would not have an impact on Quarry No. 4 or groundwater.

As part of this evaluation, Liberty will install three soil borings through the soil cover placed over the quarry at the approximate locations shown on Figure 4-1. These locations were selected because they provide a representative evaluation of the soil cover in areas covered with from 2 to almost 20 feet of soil. The soil borings will be installed using a Geoprobe[®] drill rig following the procedures discussed in Section 5.0. The soil borings will be terminated on the top of the surface of the quarry. At each boring location, soil samples will be collected continuously using a 4-foot long macrocore sampler. The soil samples will be screened for volatile organic vapors using a photoionization detector (PID) and visually inspected for signs of contamination. Also, a geologist will log the soils at each boring location using the United Soil Classification System.

Upon completion of the soil boring installation activities, drill cuttings will be placed into the borehole and the remaining annular space will be pressure grouted with bentonite. The horizontal location of the borings will also be determined so that they can be accurately plotted on site plans.

To confirm the field screening results, one soil sample at each boring location will be selected for laboratory analysis. The sample selected for analysis from each boring will be the sample that displays elevated PID readings or visual signs of contamination. If no elevated PID readings or visual signs of contamination are encountered, the sample selected for analysis will be obtained from the mid-point within the boring. That is, if the soil cover at a particular boring location is 6 feet thick the sample selected for analysis would be obtained from a depth of 3 feet. The three selected samples will be submitted for analysis of the Target Compound List (TCL) volatile and semivolatile organic compounds and the Target Analyte List (TAL) inorganics.

If perched water is encountered during the installation of the soil borings, it will be sampled. If encountered, a perched water sample will be collected from only one of the three soil borings to

be installed. The sample will be collected by installing a 1-inch diameter PVC temporary well point with a 5-foot length of screen in the borehole. The sample will then be collected using a decontaminated and dedicated polyethylene bailer. The water sample will be submitted for laboratory analysis of the TCL volatile and semivolatile organic compounds and the TAL inorganics. Since the water sample will be collected from a soil boring it will likely be very turbid. Therefore, the sample will be analyzed for dissolved metals rather than total metals.

CompuChem will analyze the soil and water samples, an EPA approved CLP laboratory located in Cary, NC. The samples will be analyzed using USEPA Method OLM04.1 (GC/MS) for the organics and USEPA Method ILM04.1 (ICP) for the inorganics.

The results of the Task 2 activities will be included in the IRDR to be developed as part of the Task 4 activities.

4.3 Task 3 - Groundwater Monitoring Program

As part of the Task 3 activities, the additional wells required to monitor groundwater quality upgradient and downgradient of Quarry No. 4 will be installed. Also, the quarterly groundwater sampling that will be used to support a request to waive the cap and drainage layer requirement for Quarry No. 4 on the basis of a demonstration that it is not necessary to limit infiltration into the quarry will be implemented.

As discussed above, the results of Task 1 will be used to determine: 1) the existing upgradient wells to be included in the groundwater monitoring program; 2) the number and final locations of wells to be installed at the site; and 3) the final list of COC to be incorporated into the groundwater monitoring program. The results of the Task 1 activities will be outlined in the IRDR and will be used to finalize the activities to be implemented as part of the groundwater-monitoring program. However, the current components of the groundwater-monitoring program are summarized below.

Section 5.0 of this RDWP includes detailed procedures that will be followed during the well installation and sampling activities.

Well Installation

As discussed above, a detailed evaluation of the hydrogeologic setting of Quarry No. 4 area will be completed during the Task 1 activities. The results of this assessment will be used to select the number and final locations of wells to be installed at the site. However, as required in USEPA's April 9, 2001 letter, at least four additional wells, two wells clusters consisting of a deep and a shallow well, will be installed to monitor any statistically significant changes between groundwater quality upgradient and downgradient of Quarry No. 4. Of the two well clusters, one will be installed upgradient and the other will be installed downgradient of Quarry No. 4.

The wells proposed for installation at the site will be installed using an air-rotary drill rig, which is the drilling method that was primarily used at the Crater site during the RI. If required, temporary steel casing may be advanced as the wells are installed to keep the boreholes from collapsing. Since these wells will be located outside of any areas of potential impact, the drill

cuttings generated above the water table will be raked into the ground surface near the well location or will be collected and raked into the ground at a suitable on-site location. Drill cuttings and water generated after encountering saturated conditions will be containerized on-site in either drums, temporary above ground storage tanks, or roll-offs pending the receipt of the groundwater analytical data. If required, the containerized drill cuttings and water will be characterized for disposal.

During the installation of the wells, split-spoon soil samples will be collected at 5-foot intervals until refusal and/or bedrock is encountered. The contents of each split-spoon will be screened in the field with a photoionization detector (PID) for volatile organic vapors and will be visually inspected for signs of contamination. Bedrock cuttings will also be collected at 5-foot intervals and screened as described above. A geologist using the Unified Soil Classification System will classify the soil and bedrock.

The completion depth of the new wells will be determined during the Task 1 activities and will be included in the IRDR. However, the shallow wells will be completed such that they monitor the first water bearing zone encountered, which is the system most likely to show any signs of impact from the quarry.

An 8-inch borehole will be drilled to the desired completion depth at each of the proposed well locations. Upon reaching the desired completion depth, a 2-inch diameter PVC well will be constructed in the boreholes. The wells will be installed and constructed as described in Section 5.0 of this RDWP. Upon installation of the wells, each will be developed using a decontaminated stainless steel submersible pump and dedicated tubing following the procedures included in Section 5.0. The development water will be stored in a temporary aboveground storage tank until the analytical results have been received. If required, the water will be subsequently characterized for disposal. The horizontal and vertical location of the newly installed wells and existing wells located downgradient of Quarry No. 4 (MW-17S, MW-17D and MW-18), and any existing upgradient wells incorporated into the groundwater monitoring program will then be determined.

Well Sampling

Each of the newly installed wells along with existing downgradient wells MW-17S, MW-17D and MW-18, proposed well MW-19S to be installed by the PRP Group, and any existing upgradient wells incorporated in the groundwater monitoring program will be sampled on a quarterly basis over a two year period for a total of eight rounds of sampling. This sampling program will allow the development of a database that can then be evaluated to determine: 1) background/upgradient concentrations for the COC; and 2) if there is a statistically significant difference between groundwater quality upgradient and downgradient of Quarry No. 4.

The first round of groundwater sampling will be completed about four weeks after the new wells have been installed, which will allow sufficient time for the wells to stabilize. The wells will then be sampled approximately every three months (quarterly) until a total of eight rounds of samples have been collected.

Prior to collecting samples, a depth-to-water level measurement will be collected from each well. The wells will then be purged and sampled using decontaminated/dedicated equipment following the low-flow purging procedures described in Section 5.0 of this RDWP. The purge water will be stored in a temporary aboveground storage tank until the analytical results have been received. If required, the water will be subsequently characterized for disposal.

The groundwater samples along with appropriate quality assurance/quality control samples (QA/QC) will be analyzed for the list of COC to be developed after completion of the Task 1 activities, which will be included in the IRDR.

CompuChem will analyze the groundwater samples, an EPA approved CLP laboratory located in Cary, NC using USEPA Method OLM04.1 (GC/MS) for the organics and USEPA Method ILM04.1 (ICP) for the inorganics. A copy of the results of each quarterly sampling event will be transmitted to the USEPA.

Data Analysis

The quarterly groundwater sampling data will be statistically evaluated to determine whether or not groundwater quality in the upgradient wells varies from that in the downgradient wells. Figure 4-2 shows a flowchart that presents options that will be followed for comparing background (upgradient) well and compliance (downgradient) well data. This flow chart will be used to guide the selection of the most appropriate statistical methods for data assessment.

As indicated on Figure 4-2, if more than 50 percent of the observations are below the laboratory reporting level or practical quantitation level (PQL), then the appropriate statistical procedure for that data set would be a test of proportions. If the proportion of detected values is 50 percent or more (as might be the case with detection of naturally occurring metals), then an analysis of variance (ANOVA) procedure will be the first choice. Analysis of variance (ANOVA) is the name given to a wide variety of statistical procedures. All of these procedures compare the means of different groups of observations to determine whether there are any significant differences among the groups, and if so, contrast procedures may be used to determine where the differences lie. Such procedures are also known in the statistical literature as general linear model procedures. Because of its flexibility and power, ANOVA is the preferred method of statistical analysis when the groundwater monitoring is based on a comparison of background and downgradient well data. The ANOVA is especially useful in situations where sample sizes are small, as is the case during the initial phases of groundwater monitoring.

Tolerance limits or prediction intervals are acceptable alternate choices that may be selected. The ANOVA procedures however, have the potential to provide a more thorough statistical description of groundwater conditions at the site.

If ANOVA is to be used, then the process summarized in Figure 4-2 will be used to select the specific method that is appropriate. Depending on conditions, a one-way analysis of variance could be implemented. If the data show evidence of seasonal variation (observed, for example, in a plot of the data over time), a trend analysis or a two-way analysis of variance may be the appropriate choice.

If the one-way analysis of variance is appropriate, the computations will be completed, and then the residuals will be checked to see if they meet the assumptions of normality and equal variance. If so, the analysis will be concluded. If not, a logarithm transformation will be completed and the residuals from the analysis of variance on the log data will be checked for assumptions. If these still do not adequately satisfy the assumptions, then a one-way nonparametric analysis of variance may be completed.

Notwithstanding the above, depending on the data set obtained, Liberty may propose to USEPA other statistical methods considered more appropriate for evaluation of the groundwater analytical results. The requirement to use other methods will be based on false positive rates (determined by methods such as Dixon's Test for Outliers), spatial variability of the data sets between each well, the normality of the data, etc. Other statistical approaches that could be proposed would include parametric and non-parametric intervals (such as Wilcoxon Mann-Whitney Tests, Friedman and Kruskal-Wallis etc), intra-well analysis (using methods such as Shewhart-CUSUM Control Charts) or trend tests (using methods such as Mann-Kendal test, Seasonal Kendal tests and Sens test).

The statistical methods and the rationale for selection of the statistical methods will be presented with the analysis. Guidance for final selection of the statistical procedures will be based on the data sets obtained from the sampling program, technical literature, and procedures outlined in USEPA guidelines (such as "Statistical Analysis of Groundwater Monitoring data at RCRA facilities – Interim Final Guidance" (PB89151047) and ensuing publications).

Liberty will provide USEPA with a quarterly interim report that provides a summary of the groundwater sample results. These interim quarterly reports will also include a description of the statistical analyses completed and the results of these analyses.

4.4 Task 4 - Reporting

This Section of the RDWP describes the reporting procedures that will be followed as part of the Quarry No. 4 Demonstration Project.

Interim Remedial Design Report

Upon completion of Tasks 1 and 2, Liberty will generate and submit to USEPA an Interim Remedial Design Report (IRDR). The IRDR will provide: 1) a detailed discussion of the hydrogeologic setting of the site including flow directions and components; 2) a water balance for Quarry No. 4, which indicates how much water is flowing through the quarry as surface water and groundwater; 3) the existing upgradient wells proposed for inclusion in the groundwater monitoring program; 4) the additional upgradient and downgradient wells to be installed including their location, depth and construction; and 5) the list of COC metals to be included in the groundwater monitoring program.

The primary objective of the IRDR is to finalize the Quarry No. 4 Demonstration Project (i.e., the Task 3 activities described above) that will be implemented to demonstrate that a cap and drainage layer is not necessary to limit infiltration and that a waiver of the cap will not cause or contribute to groundwater degradation as a result of leachate production.

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Although the contents of the IRDR will be determined after analysis of the data obtained during Tasks 1 and 2 has been completed, a tentative table of contents for the IRDR is provided below:

- 1.0 Introduction
- 2.0 Hydrogeologic Setting of the Quarry No. 4 Area
 - 2.1 Geologic Setting
 - Unconsolidated Soils
 - Bedrock
 - Quarry No. 4
 - 2.2 Hydrology
 - Groundwater Flow Directions
 - Groundwater Flow Components
 - Water Balance
- 3.0 Soil Cover for Quarry No. 4
 - 3.1 Current Site Conditions
 - 3.2 Proposed Current and Future Land Use
 - 3.3 Cover Sample Results
- 4.0 Background Concentrations For Metals in Soils
 - 4.1 Background Sampling and Results
 - 4.2 Statistical Evaluation and Development of Background Levels
 - 4.3 Comparison of Background Levels to Quarry No. 4 Sample Results
 - 4.4 Proposed List of COC Metals
- 5.0 Groundwater Monitoring Program
 - 5.1 Identification of Existing Wells to be Included in the Demonstration Project
 - 5.2 New Wells to be Installed
 - Number of Wells
 - Well Locations
 - Well Installation
 - Well Construction
 - 5.3 Well Sampling
 - Sampling Procedures
 - Laboratory Analyses
 - Data Analysis
 - Quarterly Interim Groundwater Sample Reports

If required, the Sampling and Analysis Plan and the Health and Safety Plan included in Sections 5.0 and 6.0, respectively, of this RDWP will be revised as appropriate and submitted with the IRDR.

Interim Quarterly Groundwater Sample Reports

After receipt and analysis of the analytical data, the results of each quarterly groundwater-sampling event will be tabulated and submitted to the USEPA in Interim Quarterly Groundwater Sample Reports. These reports will also include a discussion of the statistical analyses that were completed.

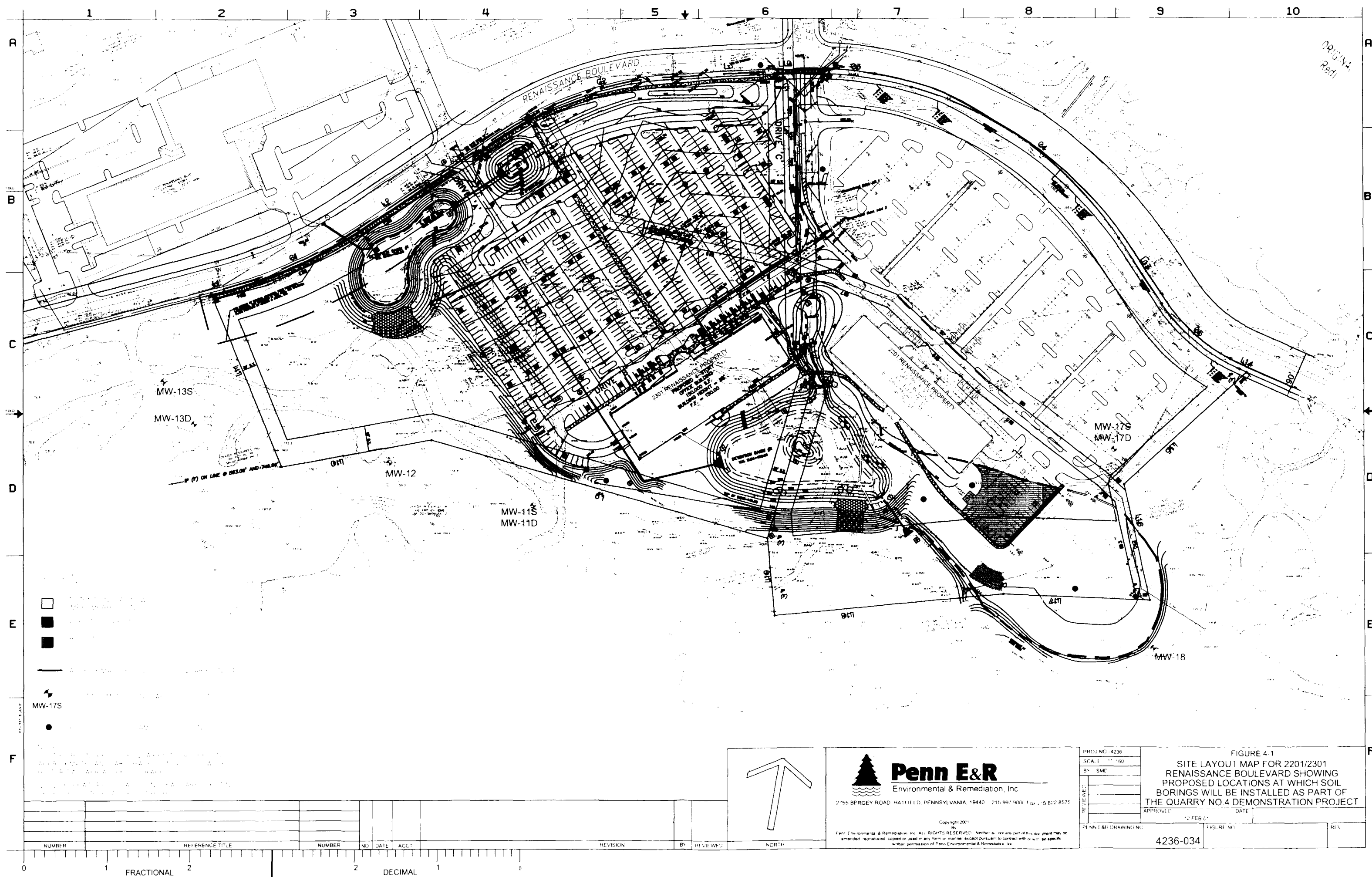
Final Remedial Design Report

Upon completion of the two-year quarterly groundwater-sampling program, Liberty will develop and submit to USEPA a Final Remedial Design Report (FRDR). This report will incorporate the IRDR and will include the results of the well installation and sampling activities, and a discussion of the statistical analysis of the groundwater sample results. Although the contents of the FRDR will be dependent upon the activities implemented and the results of these activities, a tentative table of contents for the FRDR is provided below:

- 1.0 Introduction
- 2.0 Hydrogeologic Setting of the Quarry No. 4 Area
 - 2.1 Geologic Setting
 - Unconsolidated Soils
 - Bedrock
 - Quarry No. 4
 - 2.2 Hydrology
 - Groundwater Flow Directions
 - Groundwater Flow Components
 - Water Balance
- 3.0 Soil Cover for Quarry No. 4
 - 3.1 Current Site Conditions
 - 3.2 Future Land Development and Use
- 4.0 Quarry No. 4 Demonstration Project
 - 4.1 Evaluation of Soil Cover Over Quarry No. 4
 - 4.2 Well Installation
 - 4.3 Quarterly Groundwater Sampling
- 5.0 Data Analysis
 - 5.1 Soils Over Quarry No. 4
 - 5.2 Groundwater Sample Results
 - Background/Upgradient Concentrations for the COC
 - Downgradient Concentrations for the COC
 - 5.3 Statistical Analysis

6.0 Conclusions and Recommendations

If the data analysis shows that there is no statistically significant difference between groundwater quality upgradient and downgradient of Quarry No. 4 the FRDR will request a waiver of the cap and drainage layer requirement for Quarry No. 4 as provided for in 25 Pa. Code Section 288.234 (b) on the basis of a demonstration that it is not necessary to limit infiltration into the quarry. If such a demonstration cannot be supported, the FRDR will recommend that Liberty develop the required work plans to cap Quarry No. 4.



5.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan consists of a Field sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP provides the procedures that will be followed during all field sampling and data-gathering activities and the QAPP describes the policy, organization, functional activities, and quality assurance and quality control measures necessary to achieve the data quality objectives identified for the site. The components of these two plans are presented below.

This Sampling and Analysis Plan covers the activities currently anticipated to be completed as part of the Quarry No. 4 Demonstration Project as outlined in Section 4.0 of this RDWP. The Sampling and Analysis Plan will be revised as required upon completion of the Task 1 and Task 2 activities outlined in Section 4.0 and submittal of the Interim Remedial Design Report.

5.1 Background Information

5.1.1 Proposed Quarry No. 4 Demonstration Project

As shown on Figure 5-1, Quarry No. 4 is located in the southeast corner of Liberty's 2201 Renaissance Boulevard property. The former quarry, which was historically filled primarily with earthen material, is about 675 feet long by, at its maximum, 275 feet wide. Approximately 80 percent of the quarry is located on Liberty's 2201 property. The other 20 percent is located off of the 2201 property on properties to the east and south. As discussed in Section 3.0, a majority of the on-site portions of the quarry have been covered with 2 plus feet of soil as part of the development of the 2201 property.

On January 24, 2001, Liberty met with PADEP and USEPA to discuss its proposal for satisfying the capping requirements for Quarry No. 4 as set forth in the ROD for the Crater site pursuant to a proposed settlement with the USEPA. Liberty's presentation at the meeting and in its written report, described how Liberty has already covered much of Quarry No. 4 in the brownfield redevelopment of the Yellow Property, which was coordinated with the USEPA. Further, it demonstrated how existing and planned conditions over Quarry No. 4 satisfy Pennsylvania's residual waste landfill capping requirements as called for in the ROD. At the meeting, however, PADEP requested some additional information to support this demonstration. In addition, in light of the technical data discussed at the meeting, PADEP recommended that Liberty refocus its demonstration from a showing that capping standards have been satisfied or meet criteria for modifications, to a showing that the cap and drainage layer requirements of the regulations should be waived on the basis that unacceptable leaching is not occurring through the materials in the quarry. Such waiver is specifically provided in the capping regulations cited in the ROD.

In response to the results of this meeting, Liberty prepared and submitted to the PADEP and USEPA on February 12, 2001 a document entitled "Proposal to Cap Quarry No. 4". PADEP and USEPA subsequently reviewed the Proposal to Cap Quarry No. 4 and USEPA issued a comment letter dated April 9, 2001. As outlined in the letter, PADEP and USEPA indicated that they did not believe that existing structures and soil placed over Quarry No. 4 by Liberty satisfied the cap/drainage layer/cover requirements in 25 Pa. Code 288.234. Also, PADEP and

USEPA indicated that they did not believe that the proposal contained sufficient information to demonstrate that it was not necessary to limit infiltration into the quarry. However, they acknowledged that based on available data, a waiver may still have merit and indicated that if Liberty wished to pursue the waiver option, additional information and data would need to be generated and evaluated. Section 4.0 of this RDWP outlines the additional data gathering and evaluation activities that will be implemented to support a request to waive the cap and drainage layer requirement for Quarry No. 4 and to address comments included in USEPA's April 9, 2001 letter. These activities will be finalized upon completion of the Task 1 and Task 2 activities outlined in Section 4.0 and submittal of the Interim Remedial Design Project. This Section of the RDWP provides the procedures that will be followed during all field sampling and data-gathering activities and describes the policy, organization, functional activities, and quality assurance and quality control measures necessary to achieve the data quality objectives identified for the site.

5.1.2 Results of Soil Sampling Completed in Quarry No. 4

Section 2.2 of the RDWP describes in detail the results of the soil sampling that has historically been completed within the boundaries of Quarry No. 4.

5.1.3 Groundwater Conditions Hydraulically Downgradient of Quarry No. 4

Section 2.3 of the RDWP describes in detail ground water conditions hydraulically downgradient of Quarry No. 4.

5.2 Field Sampling Plan

This Field Sampling Plan outlines the procedures that will be followed during all on-site field investigation activities. As discussed in Section 4.0, these field investigation activities currently include the following:

- **Soil Boring Installation and Sampling**
- **Monitoring Well Installation and Sampling**

The procedures and methodologies to be followed during the implementation of these activities are detailed below.

5.2.1 Soil Boring Installation and Sampling

5.2.1.1 Overview

As discussed in Section 3.0, a majority of the surface of Quarry No. 4 was covered with 2 plus feet of soil as part of the development of the 2201 Renaissance Boulevard property. A majority of this soil was obtained from the northern portions of the 2201 property, which were cut to required construction grades, and used to fill the southern portions of the site including areas over Quarry No. 4. Although there is no evidence that these soils were impacted in any way by Site contaminants, the USEPA, in its April 9, 2001 comment letter, requested that Liberty

evaluate these soils to ensure that their presence would not have an impact on Quarry No. 4 or groundwater.

As part of this evaluation, Liberty will install three soil borings through the soil cover placed over the quarry at the approximate locations shown on Figure 5-2. One soil sample from each of the borings will be selected and submitted for analysis of the Target Compound List volatile and semivolatile organic compounds and the Target Analyte List inorganics. The results of the analysis of these samples will be used to confirm that the soil cover placed over the quarry has not and will not impact Quarry No. 4 or the ground water.

5.2.1.2 Soil Boring Installation

The soil borings will be installed using a Geoprobe® drill rig. The drill rig and all downhole equipment will be decontaminated following the procedures presented in Section 5.2.6 prior to commencement of drilling, between each boring location, and prior to leaving the site. Soil samples will be collected continuously at each boring location using 4-foot long decontaminated stainless steel macrocore samplers. A dedicated polyethylene tube will be placed inside each macrocore sampler. The sampler will be pushed to its desired depth and then retrieved from the borehole. The macrocore sampler will be placed directly on plastic sheeting after it is removed from the borehole. The top half of the polyethylene tube will be sliced open and removed to expose the 4-foot long soil core.

The soil core will be immediately screened with a photoionization detector (10.6 eV bulb) for the presence of volatile organic vapors and visually inspected for signs of contamination. A lithologic description of the soils will be completed by the geologist using the Unified Soil Classification System. The thickness of the soil cover over the quarry will be confirmed at each of the boring locations. This process will be continued until the desired completion depth of the borings, which will be the top of the quarry, has been reached.

Upon completion, any remaining soil cuttings will be placed back in the hole in the reverse order from which they were removed. Each borehole will then be sealed with a cement/bentonite grout mixture. The grout will be installed under pressure using a tremie line.

The horizontal location of each boring will be surveyed so that they can be accurately located on site maps.

As discussed in Section 6.0, a 25-foot diameter exclusion zone will be established around the drill rig at each boring location using caution tape.

5.2.1.3 Soil/Water Sampling

To confirm the field screening results, one soil sample at each location will be selected for laboratory analysis. The sample selected for analysis from each boring will be the sample that displays elevated PID readings or visual signs of contamination. If no elevated PID readings or visual signs of contamination are encountered, the sample selected for analysis will be obtained

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from the mid-point within the boring. That is, if the soil cover at a particular boring location is 6 feet thick the sample selected for analysis would be obtained from a depth of 3 feet.

Prior to the collection of the samples, plastic sheeting will be placed on the ground adjacent to the boring. Any equipment used during the sampling activities will be placed on the plastic sheeting. The sample technician will then don nitrile gloves to limit any possible chance for cross-contamination, and the sampling, as described below, will be implemented.

The volatile organic fraction for each sample will be collected first using a dedicated Encore™ sampler. After removing the sampler from its bag, its sample handle will be installed. The Encore™ sampler will then be slowly pushed into the soil core at the desired sampling interval. After ensuring that the sampler is full, but not overfilled to prevent the cap from being properly secured, the sampler will be removed and capped. Any soil on the outside of the sampler will be wiped off using paper towels. A filled out label will be placed on the sampler and the sampler will be placed back into its laboratory supplied zip-lock bag. The label on the outside of the bag will be completed and the bag will be placed on ice in a cooler. As summarized in Table 5-1, all samples will be kept at 4° C, and three 5-gram samplers will be collected at each location for volatile organic analysis.

After collecting the volatile organic fraction of the sample, a decontaminated hand-held stainless steel spoon will then be used to collect a sufficient volume of soil to complete the remaining analyses. The soil from the desired interval in the macrocore sampler will be transferred directly into a stainless steel mixing bowl using a stainless steel spoon or spatula. The soil in the mixing bowl will then be thoroughly homogenized using a stainless steel spoon. After homogenization, the required laboratory supplied sample bottles will be filled. The required volume of soil, as summarized in Table 5-1, will be placed in each jar. The sample jars will then be labeled and placed into a cooler with ice. All samples will be kept at 4° C.

If perched water is encountered during the installation of the soil borings, it will be sampled. If encountered, a perched water sample will be collected from only one of the three soil borings to be installed. Prior to collecting the sample, a temporary well point will be installed in the boring. The temporary well point will consist of decontaminated 1-inch diameter PVC casing with a 5-foot length of screen. The well point will be completed either on top of the quarry or five feet below the depth at which perched water is first encountered, whichever occurs first. A water sample will then be collected from the well point using a decontaminated and dedicated polyethylene bailer. All required laboratory supplied sample bottles will be appropriately filled, starting with the volatile organic fraction of the sample. Immediately after collection, the sample bottles will be placed on ice in a cooler that will be maintained at 4 degrees Celsius. The following is a list of equipment that will be available during the soil/water sample collection activities:

- Remedial Design Work Plan
- Laboratory supplied sample containers and cooler with ice and/or ice packs
- Chain-of-custody labels, tags and seals
- Surgical gloves

- Decontamination equipment including buckets, brushes, tap water, soap and water mixture, pesticide grade acetone, dilute nitric acid solution, and deionized water
- Sampling devices including Encore™ samplers, stainless steel spoons, stainless steel mixing bowls, and bailers.
- Field book and indelible ink markers to record all sampling activities
- Site map to mark and identify sample locations

Other equipment as may be required to complete the sampling will be provided.

5.2.1.4 Laboratory Analyses

The three soil samples and, if encountered, the perched water sample, will be analyzed for the Target Compound List (TCL) volatile organic and semivolatile organic compounds and the Target Analyte List inorganics. Since the water sample will be collected from a soil boring it will likely be very turbid. Therefore, the perched water sample will be analyzed for dissolved metals rather than total metals. The blind duplicate and equipment rinsate blank to be collected as part of the sampling activities will be analyzed for the same compounds. The trip blank will be analyzed for the TCL volatile organic compounds only. CompuChem will analyze the samples, an EPA approved CLP laboratory located in Cary, NC. The volatile and semivolatile organic analyses will be performed using USEPA Method OLM04.2 (GC/MS) and the inorganic analyses will be performed using USEPA Method ILM04.1 (ICP).

The analyses to be completed on the samples, including required analytical methodologies, are summarized in Table 5-1. Also, the analytical method detection limits and the reporting limits for the various compounds/analytes to be tested for are presented in Section 3.6.3 of CompuChem's Quality Assurance Manual (see Attachment 5A).

5.2.2 Monitoring Well Installation and Sampling

5.2.2.1 Overview

As discussed in Section 2.0, there are three wells currently located hydraulically downgradient of Quarry No. 4. These wells are designated MW-17S, MW-17D and MW-18 and they are located as shown on Figure 5-2. In an effort to supplement these wells and ensure that a representative evaluation of ground water quality both upgradient and downgradient of Quarry No. 4 is completed, additional wells will be installed at the site. As discussed in Section 4.0, a detailed evaluation of the hydrogeologic setting of the Quarry No. 4 area will be completed. The results of this assessment will be used to select the number and final locations of wells to be installed at the Site. However, as required by USEPA in their April 9, 2001 letter, at least four additional wells, two well clusters each consisting of a deep and a shallow well, will need to be installed to monitor any changes in ground water quality upgradient and downgradient of Quarry No. 4. Of these two well clusters, one will be located upgradient and the other downgradient of Quarry No. 4. The final number and location of wells to be installed will be determined after completion of the activities outlined in Section 4.0 and will be included in the Interim Remedial Design Report (IRDR).

The new wells to be installed at the site, the three wells currently located downgradient of Quarry No. 4 (i.e., wells MW-17S, MW-17D and MW-18), the well proposed for installation by the PRP Group, well MW-19S, and any existing upgradient wells incorporated into the ground water monitoring program will be sampled on a quarterly basis for two years for a total of eight rounds of sampling. The samples collected from these wells, as well as associated QA/QC samples, will be analyzed for list of contaminants of concern (COC) to be developed after completion of the Task 1 activities discussed in Section 4.0, which will be included in the IRDR. The results of these analyses will be evaluated, following the procedures discussed in Section 4.3, to determine if there is a statistically significant difference between ground water quality upgradient and downgradient of Quarry No. 4.

5.2.2.2 Well Installation

The monitoring wells will be installed using an air-rotary drill rig. The wells will be installed by Talon Well Drilling Company (Talon) located in Trenton, NJ. A copy of Talon's Qualifications and Experience brochure is included in Attachment 5B. Talon is familiar with the hydrogeologic setting of this area, as some of their drillers have previously been involved with well drilling activities on the Crater site.

A 6-inch diameter borehole will be advanced to its desired depth at each proposed well location. The deep well at each location will be installed first and the two wells at each cluster location will be separated by at least 5 feet. If required, decontaminated temporary steel casing may be advanced as the wells are installed to keep the boreholes from collapsing. Since these wells will be located outside of any areas of potential impact, the drill cuttings generated above the water table will be raked into the ground surface near the well location or will be collected and raked into the ground at a suitable on-site location. Drill cuttings and water generated after encountering saturated conditions will be containerized on-site in either drums, temporary above ground tanks, or roll-offs pending the receipt of the ground water analytical data. If required, the containerized drill cuttings and water will be characterized for disposal.

During the installation of the wells, split-spoon soil samples will be collected at 5-foot intervals until the desired completion depth, refusal and/or bedrock is encountered, whichever occurs first. The contents of each split-spoon will be screened in the field with a photoionization detector (PID) for volatile organic vapors and will be visually inspected for signs of contamination. Bedrock cuttings will also be collected at 5-foot intervals and screened as described above. A geologist using the Unified Soil Classification System will classify the soil and bedrock.

Upon reaching the desired completion depth, a 2-inch diameter PVC well will be constructed in the boreholes. The wells will be installed and constructed as described below. The horizontal and vertical locations of the new wells, existing wells MW-17S, MW-17D and MW-18, and any existing upgradient wells incorporated into the ground water monitoring program will be determined.

5.2.2.3 Well Construction

The wells will be constructed of 2-inch diameter, flush-jointed Schedule 40 PVC casing with a 10 to 20-foot long bottom section of 0.01-inch slotted screen. The well casings will be attached to the well screen by flush-jointed threads and centered into the borehole with centralizers. Prior to setting the well, a 6-inch thick sand pack will be placed at the bottom of the borehole to serve as a footing. The casing and screen sections will then be lowered into the borehole and centered. Teflon tape and/or Teflon "O" rings may be used to insure a tight fit and minimize leakage.

An appropriately sized sand pack will be installed in the annular space between the well screen and borehole. The sand pack will be capable of filtering out silt, clay and fine particulate matter from entering and potentially clogging the well screen. The filter pack will consist of Morie™ graded sand as geologic conditions indicate. Morie sand is composed of sub-rounded to well rounded, No 1. (or No. 2) hard silica sand available in 90 lb. bags. The sand pack will extend from the bottom of the well screen to a level at least 2 feet above the screen. The sand pack will be placed by tremie method, positive displacement methods or by "pouring". If by pouring, care will be taken to evenly distribute the sand pack around the well screen as it is being poured into the borehole.

A 2-foot thick bentonite pellet seal will be placed directly on top of the sand pack. The bentonite pellets will be installed by either the tremie method, positive displacement method or by pouring. If required, potable or clean water will be used to hydrate the pellets immediately after they are applied.

Following placement of the bentonite pellet seal, the remaining annular space will be grouted using a mixture of 30% bentonite solids and cement grout. The grout will be installed in the annular space between the well casing and the borehole using the tremie method. The grout will be installed after the bentonite seal has been hydrated from the top of the bentonite seal to within 2 feet of the ground surface. The grout will be allowed to cure in the borehole for a minimum of 14 hours prior to installation of the concrete surface pad and wellhead protective outer casing. The grout will be mixed using 7 gallons of water per 94lb bag of Type 1 Portland cement. Between 5 and 10 percent bentonite will be added to the cement to delay the setting time and prevent irregular shrinking/drying.

The wells to be installed just northeast of the quarry will be completed flush with the ground surface. These wells will be finished with watertight 6-inch steel protective casings having locking caps. The wells to be installed upgradient and west of the quarry will be completed with 2-foot of stickup and will be protected with 6-inch steel protective casings having locking caps. The protective outer casing will be completed by pouring wet concrete into the borehole above the cured annular grout layer. The wet concrete will be smoothed and filled in so that the inner elevation is tight with the casings.

5.2.2.4 Well Development

Following installation, the new wells will be developed to remove residual drilling materials, grade the filter pack and reestablish conditions of natural ground water flow. The wells will be

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developed using a decontaminated stainless 2 or 4-inch submersible pump and dedicated polyethylene tubing. The development water will be discharged directly into a temporary above ground storage tank. The final disposition of this water will be determined after the ground water analytical results have been obtained and reviewed. If required, this water will be properly characterized and shipped off-site for disposal.

During the well development activities, in situ field measurements for pH, temperature, dissolved oxygen and specific conductivity will be collected. The wells will be developed until a sediment free discharge is observed and the pH, temperature, dissolved oxygen and specific conductivity have stabilized. All well development procedures including the total volume of water removed, the rate of removal, and the in situ field measurements will be recorded in the field log book.

5.2.2.5 Well Sampling

All ground water sampling equipment will be constructed of inert material and will be dedicated or decontaminated prior to its use and between each well location. The following equipment will be available during the on-site sampling activities:

- Field Sampling and Quality Assurance Project Plans
- Laboratory supplied sample containers and cooler with ice and/or ice packs
- Chain-of-custody labels, tags and seals
- Latex and/or nitrile gloves
- Plastic sheeting
- Well keys
- 2-inch stainless steel submersible pump, DTW meter and water quality meter
- Generator
- Disposable metal water filter unit
- Dedicated teflon-lined polyethylene tubing
- Decontamination equipment including buckets, brushes, tap water, soap and water mixture, pesticide grade acetone, dilute nitric acid solution, and deionized water
- Field book and indelible ink markers to record all sampling activities
- Site map to mark and identify sample locations
- Well construction information

All monitoring wells will be inspected for integrity, access and tampering prior to sample collection. After completion of this inspection, a depth-to-water (DTW) level measurement will be collected from the four new wells, existing wells MW-17S, MW-17D and MW-18, proposed well MW-19S to be installed by the PRP Group, and any existing upgradient wells incorporated into the ground water monitoring program. The water level probe will be kept clean and in good working order and turned on prior to each measurement to check and ensure that the battery is charged. The probe will be lowered into the well until the electronic signal indicates that the water depth has been reached and the circuit completed. At that point the graduated tape will be read and the reading recorded in the field logbook. Depth to water measurements will be made relative to the top of the inner PVC casing, which will be marked as a reference for future measurements. All measurements will be determined to the nearest 0.01 foot.

After collection of the DTW level measurements, the wells will be purged using a decontaminated stainless steel 2-inch Grundfos Redi-Flo submersible pump and dedicated teflon-lined polyethylene tubing. The submersible pump will be slowly lowered into the well and the pump will be set at the midpoint of the well screen. The wells will then be purged at a rate of 200 to 1000 milliliters per minute (ml/min.). The water level in the well will be gauged during purging and maintained, as possible, with little or no drawdown. This will be done to ensure that the water removal rate is somewhat equal to the water recharge rate from the targeted water-bearing zone.

Prior to, during and after purging, in situ field measurements for pH, temperature, specific conductance and dissolved oxygen will be obtained using a Horiba U-20 instrument (or equivalent) until the readings have stabilized. Measurements will be collected every 3 to 5 minutes. Stabilization will have been considered to be reached when the in situ measurements have stabilized for three or more successive readings. The three successive readings should be within ± 0.1 for pH, ± 3 percent for specific conductance, ± 10 percent for dissolved oxygen, and ± 10 percent for temperature. The in situ measurements will be obtained from a flow-through cell so they can be made before the purge water is exposed to the atmosphere.

All purge water will be containerized in a temporary above ground storage tank. The final disposition of this water will be determined after the ground water analytical results have been obtained and reviewed. If required, this water will be properly characterized for disposal.

After the in situ measurements have stabilized, the wells will be sampled. The samples will be collected directly from the dedicated tubing used to purge the wells. All required laboratory supplied sample bottles will be appropriately filled, starting with the volatile organic fraction of the sample. Immediately after collection, the sample bottles will be placed on ice in a cooler that will be maintained at 4 degrees Celsius.

As indicated earlier, the ground water samples will be analyzed for both total and dissolved metals. The sample for total metals analysis will be collected directly into the preserved laboratory sample container supplied by the laboratory (see Table 5-1). The fraction of the sample to be submitted for dissolved metals analysis will be discharged directly into a decontaminated and disposable 500 ml Nalgene™ filtration unit. This filtration unit consists of an upper 500 ml plastic container and a lower 500 ml plastic container that are separated by a bottleneck onto which a vacuum pump can be connected. A 0.45-micron filter is located at the bottom of the upper 500 ml container. A hand pump will be connected to the nipple on the bottleneck to create a vacuum in the filtration unit so that the water in the upper container is drawn through the 0.45-micron filter and collected in the lower 500 ml container. After a sufficient volume of water has been filtered, it will be poured directly into a laboratory bottle that has been appropriately preserved (see Table 5-1).

The following information will be recorded in the field logbook during the well purging and sampling activities:

- Initial depth-to-water level measurement

- Start and end time of purging
- Total volume of water purged
- In situ field and DTW level measurements throughout the purging activities
- Purging method and equipment used
- Appearance of purge water
- Number and type of sample bottles filled
- Number of wells sampled and the well designation
- Number and type of QA/QC samples collected

5.2.2.6 Laboratory Analyses

The ground water samples will be analyzed for the list of contaminants of concern (COC) to be developed after completion of the Task 1 activities discussed in Section 4.0, which will be included in the IRDR. The samples will be analyzed for both total and dissolved metals. The blind duplicates, matrix spikes and matrix spike duplicates, and equipment rinsate blanks to be collected as part of the ground water sampling activities will be analyzed for the same compounds. CompuChem will analyze the samples, an EPA approved CLP laboratory located in Cary, NC. The analyses will be performed using USEPA Method OLM04.1 (GC/MS) for the organics and USEPA Method ILM04.1 (ICP) for the inorganics.

The analyses to be completed on the samples including required analytical methodologies, are summarized in Table 5-1. Also, the analytical method detection limits and the reporting limits for the metals to be potentially tested for are presented in Section 3.6.3 of CompuChem's Quality Assurance Manual (see Attachment 5A).

5.2.3 Quality Assurance/Quality Control Samples

The quality assurance/quality control (QA/QC) samples that will be collected as part of the Quarry No. 4 Demonstration Project are presented and discussed in Section 5.3.8 of the Quality Assurance Project Plan.

5.2.4 Sample Designation

Each sample collected as part of the Quarry No. 4 Demonstration Project will be assigned its own unique sample identification number. Samples will be labeled using a three-part code as follows:

Q4-MW17D-S

1. Name of Area: Quarry No. 4 Demonstration Project (Q4)
2. Location of Sample: Monitoring Well 17D (MW17D). The soil samples will be designated S1 through S3. The perched water sample, if one is collected, will be designated PW1. The blind duplicate samples will be assigned the same designation as the environmental sample but an A will be added to the end of the sample designation. As an example, a blind duplicate collected from well MW-17D would be labeled MW17DA. The locations from which

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the blind duplicates are collected will be recorded in the field book. Matrix spikes and matrix spike duplicates will be provided the same number that was given to the environmental sample but the sample designation will be preceded by the prefix MS for matrix spikes and MSD for matrix spike duplicates. As an example, the matrix spike and matrix spike duplicate generated at well MW-17D would be designated MW17DMS and MW17DMSD, respectively. The equipment rinsate and trip blanks will be designated ERB and TB, respectively.

3. Matrix: S for soil and W for water.

5.2.5 Sample Documentation, Handling and Shipment

The sample documentation procedures that will be implemented to ensure that proper chain-of-custody is maintained are discussed below.

Field Book

All soil and ground water sampling activities associated with the sample collection activities will be maintained in a bound field logbook. All relevant information associated with the sample collection activities will be maintained in the field book. At a minimum, the following information will be maintained in the field logbook:

- Date and time of sampling
- Persons completing the sampling
- Weather conditions at the time the samples were collected
- Results of field screening observations
- Sample designation and analyses requested to be completed
- Decontamination procedures implemented
- Type of equipment used to collect the samples
- Number of laboratory bottles collected and submitted for each location
- Sample collection depths and locations
- Quality assurance/quality control samples collected
- The location and designation of any blind duplicate samples collected
- Any unusual conditions observed during the sample collection activities

Sample Tags

A self-adhesive sample label will be attached to each container immediately prior to or after sample collection. The sample tags will contain the following information

- Project name
- Sample collection date and time
- Sample designation
- Sampler(s) name
- Preservatives present in the sample bottle
- Analyses requested

- Sample media and an indication of whether the sample is a grab or composite
- Initials of the sampler(s)

A copy of the CompuChem sample tags that will be used for the post-excavation sampling activities is provided in Attachment 5C. The sample tags will be filled out using waterproof, non-eraseable black ink.

Chain-of Custody Record

Chain-of-custody is the process of tracking the handling of the sample from time of collection to analysis. A sample is under custody if it is in: 1) one's possession; 2) one's view after being in one's possession; 3) one's possession and stored in a secured area; and/or 4) a designated secure area. To ensure that proper custody of the samples collected is maintained at all times, a chain-of-custody (COC) record will be completed by the Field Operations Manager for each shipment of samples to the laboratory. The completed COC will be sealed in a zip-lock bag and taped to the inside lid of the cooler. When samples are being transferred (i.e., from the field to the laboratory), each person involved in the transfer must sign off on the COC record.

A copy of the CompuChem COC record that will be used for the post-excavation sampling activities is provided in Attachment 5C. The COC record will be completed using waterproof, non-eraseable black ink.

Sample Preparation and Shipment

Prior to shipment, the sample tags on each bottle will be inspected to ensure that they have been properly completed and all information has been provided. Each sample container will then be placed in a zip-lock plastic bag and then into a metal or molded plastic insulated cooler. The coolers will be packed with ice or dry ice to ensure that the temperature inside the cooler is maintained at 4 degrees Celsius during its trip back to the laboratory. The bottles will be packed in the cooler to minimize potential damage during shipping. Also, a thin layer of styrofoam peanuts will be placed on the bottom of the cooler and in the annulus between the bottles in an effort to further reduce any damage to the sample bottles during shipment.

The COC record will be placed in a sealed zip-lock bag and taped to the inside lid of the cooler. The cooler lid will be shut and fastened. Plastic shipping tape will be used to secure the drain and the lid. Two custody seals, one at each end of the cooler, will then be sealed to the cooler so that any tampering of the cooler (i.e., opening of the lid) can be documented by the laboratory. A copy of the CompuChem Custody Seal that will be used for the sampling activities is provided in Attachment 5C.

All sample coolers will be shipped directly to the laboratory using an overnight express delivery service following all appropriate DOT regulations. Upon receipt, the laboratory will inspect the cooler to make sure that it has not been tampered with and will compare the COC record to the contents of the cooler. A laboratory control number will be assigned to the samples and the samples will be logged into the laboratory computer sample inventory and tracking system.

5.2.6 Decontamination Procedures

Procedures for cleaning sampling, drilling and other equipment are detailed in this section. The procedures are designed for use by personnel in the field. Any deviations from these procedures will be documented in the field logbook.

Drilling Equipment

All non-dedicated drilling equipment including downhole rods and split spoon samplers, will be cleaned with tap water and soap using a brush to remove surface matter, stains and films. After cleaning, the equipment will be rinsed thoroughly with tap water.

Sampling Equipment

All non-disposable sampling equipment will be decontaminated in accordance with the following procedures prior to its use and between sample location.

- Manual scrub to remove all visible dirt and mud;
- Rinse with tap water
- Wash with a tap water and non-phosphate soap solution
- Rinse with tap water
- Rinse with deionized water
- Rinse with a dilute nitric acid solution
- Rinse with deionized water
- Rinse equipment with pesticide-grade acetone
- Allow equipment to air-dry

If the equipment is to be stored or transported, it will be wrapped in aluminum foil. All decontamination activities will be documented in the field logbook.

The submersible pump will not be removed from the well between purging and sampling operations. The outside of the pump (including support cable and electrical wires that are in contact with the sample) will be decontaminated following the procedures described above. In addition, decontamination fluids will be pumped from buckets through the pump between each well location as follows:

- Tap water flush to remove sediment that may be trapped in the pump
- Non-phosphate detergent flush
- Tap water flush to remove residual detergent
- Dilute nitric acid and tap water flush
- Deionized water flush

Water Quality and Depth to Water Meters

All pH, temperature, specific conductance and DO meters, and depth to water probes will be rinsed thoroughly with distilled or deionized water prior to each use.

5.3 Quality Assurance Project Plan

This Quality Assurance Project Plan (QAPP) outlines the data collection and environmental measurement procedures that will be implemented during the soil and ground water sample collection activities. The objective of this QAPP is to outline the quality assurance/quality control (QA/QC) procedures that will be followed during sample collection and analysis, data reduction, validation and evaluation activities.

5.3.1 Project Organization and Responsibilities

The lead regulatory Agency for the site is USEPA Region III. Mr. Joseph McDowell is USEPA's Remedial Project Manager. PADEP will also provide technical oversight on this project.

Remedial Design/Remedial Action Contractor

Penn E&R is the Remedial Design/Remedial Action Contractor and will oversee the implementation of the Quarry No. 4 Demonstration Project as outlined in Section 4.0. Penn E&R will also oversee and manage all other aspects of the project, including the coordination of all subcontractors, data analysis and evaluation, and will prepare the Report of Findings. Penn E&R will also develop and submit all required progress reports to the USEPA/PADEP. Environmental Standards, located in Valley Forge, PA, will complete the data validation activities and CompuChem, a CLP-approved laboratory located in Cary, N.C. will be the project analytical laboratory. Both Environmental Standards and CompuChem will report directly to Penn E&R's Quality Assurance Officer. The key personnel assigned to this project by Penn E&R and Environmental Standards/CompuChem are discussed below.

Project Manager

To ensure that all project activities are completed in accordance with this Remedial Design Work Plan, Michael A. Christie, P.G., Vice President, will function as Penn E&R's Project Manager. Mr. Christie will govern all work assignments and internal team resources to complete each task safely and efficiently. Mr. Christie will provide interface with the USEPA/PADEP, as required, and will review and approve all project deliverables. Mr. Christie has over fourteen years of professional experience in the management of projects similar in scope to the activities to be implemented as part of the Quarry No. 4 Demonstration Project.

Field Operations Manager

Jeffrey Goudsward will manage all field operation tasks for Penn E&R. Mr. Goudsward has direct experience completing similar projects and is very familiar with the site, as he has assisted with the other on-site investigations. He is familiar with the field sampling techniques and all appropriate health and safety protocols, which will be required to ensure the successful completion of this project. Mr. Goudsward is a geologist and has ten years of related project

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experience. He will be on-site to oversee and document all remedial activities and will help ensure that they are implemented in accordance with the requirements of this RDWP.

Corporate Health and Safety Officer

Christopher Branton, C.I.H., has ten years of experience in areas related to occupational health and safety and industrial hygiene. This experience includes managing projects regarding regulatory compliance, health effects and risk assessment, process safety management, and respiratory protection. Mr. Branton is Penn E&R's Corporate Health and Safety Officer. Along with the designated on-site Health and Safety Coordinator, Mr. Branton will be responsible for ensuring that all field activities are implemented in accordance with the Site-Specific Health and Safety Plan (see Section 6.0).

On-Site Health and Safety Coordinator

Mr. Thomas Christie will be Penn E&R's on-site health and safety coordinator. Mr. Thomas Christie has over 10 years of experience related to the implementation of similar investigations. He will be responsible for ensuring that all field activities are implemented in accordance with the Site-Specific Health and Safety Plan and for implementing all on-site monitoring to ensure that appropriate Action levels are not exceeded. Mr. Christie will also assist the Field Operations Manager with the oversight of the site investigation activities and collection of the ground water and soil samples.

Quality Assurance/Quality Control Officer

Mr. Jeffery Fehr, P.G., Senior Project Manager, will serve as the project Quality Assurance/Quality Control (QA/QC) Officer. He has been responsible for designing and conducting a variety of QA/QC services related to various site investigation projects. Mr. Fehr will be responsible for monitoring, reviewing, and approving all reports. He will provide critical review for all phases of the project, including the field sampling activities, and will be responsible for ensuring the procedures outlined in this QAPP are adhered to at all levels of the project. Mr. Fehr will coordinate and oversee the activities of Environmental Standards, the project's Data Validation Specialist and CompuChem, the project's CLP approved analytical laboratory.

Project Support Personnel

Penn E&R will assign appropriate support personnel to this project as may be required. Any additional personnel assigned to this project will be fully experienced in the soil and ground water investigation to be implemented as part of the Quarry No. 4 Demonstration Project.

A copy of a resume for each of the key Penn E&R personnel assigned to this project is included in Attachment 5D.

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Data Validation Specialist

As indicated above, Environmental Standards, located in Valley Forge, PA will complete the data validation activities. ES is recognized as an industry leader in data validation and has completed the required validation activities on numerous similar projects. Mr. Donald Lancaster is one of Environmental Standards' most qualified and experienced chemists in the area of data validation and will serve as Data Validation Coordinator for the project. Mr. Lancaster's responsibilities will include tracking the analytical data deliverable receipt schedules to allow proper allocation of internal staff resources to this project. Mr. Lancaster will be responsible for matching the laboratory data deliverables with the project validation requirements based on work assignments and assigning staff to perform the validations efforts. Furthermore, he will be responsible for addressing data deliverables deficiencies with the laboratory based upon the validation requirements. He will track the progress of the various validation efforts to ensure compliance with delivery schedules to Penn E&R. Laboratory timeliness in response to data deliverable deficiencies will be tracked by Mr. Lancaster and the Penn E&R Quality Assurance Officer will be informed of any problems. Mr. Lancaster will report directly to the Penn E&R's Quality Assurance Officer.

A copy of Environmental Standard's Qualification and Experience Summary, along with a resume for Mr. Lancaster, is provided in Attachment 5E.

Analytical Laboratory

CompuChem will complete all laboratory analyses associated with this project, a CLP approved laboratory located in Cary, N.C. CompuChem's Quality Assurance Officer has the responsibility for ensuring that all laboratory quality assurance activities associated with this project are properly implemented. CompuChem's Quality Assurance Officer is Ms. Linda Carter. A copy of CompuChem's Quality Assurance Manual, along with a resume for Ms. Carter, is provided in Attachment 5A.

5.3.2 Quality Assurance Objectives for Measurements

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. Penn E&R's Project Manager, in conjunction with the Quality Assurance Officer, is responsible for defining the DQOs. The intended use of data, analytical measurements, and the availability of resources are an integral part in development of the DQOs. DQOs define the total uncertainty in the data that is acceptable for each specific activity during sampling events. This uncertainty includes both sampling error and analytical instrument error. Ideally, the prospect of zero uncertainty is the intent; however, the variables associated with the collection process (field and laboratory) inherently contribute to the uncertainty of the data. The overall quality assurance objective is to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. In order to achieve this objective, specific data quality requirements, such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness, will be specified. The overall objectives and requirements for this project have been established to ensure a high degree of confidence in the data obtained.

5.3.2.1 PARCC - Definitions and Equations

Data quality and quantity are measured by comparison of resulting data with established acceptable limits for data precision, sensitivity, accuracy, representativeness, comparability, and completeness (PARCC) as described in USEPA document EPA/540/G-87/003 titled, "Data Quality Objectives for Remedial Response Activities." Data that have certain aspects that may be outside of PARCC QA objectives will be evaluated (according to Section 3.2.3 of the above DQO document) and the criteria contained in the specified analytical methods, to determine what, if any, aspects of the data can be defensibly used to meet the project objectives.

Precision

Precision measures the reproducibility of data or measurements under specific conditions. Precision is a quantitative measure of the variability of a group of data compared to the average value of the data. Precision is usually stated in terms of relative percent difference (RPD) or relative standard deviation (RSD). Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, RPD will be used in this project. For a series of measurements, RSD will be used. The total precision of a series of measurements can be related by the additive nature of the variances. Equations for RPD and RSD are presented below:

$$RPD = \frac{|D1 - D2| * 100}{(D1 + D2) / 2}$$

Where:

D1 and D2 = the two replicate values

$$S = \sqrt{\frac{\sum_{i=1}^n (x - x_i)^2}{n - 1}}$$

$$RSD = \frac{S * 100}{x}$$

Where:

S	=	standard deviation
x _i	=	each observed value
x	=	the arithmetic mean of all observed values
n	=	total number of values

Accuracy

Accuracy measures the bias in a measurement system that may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

Accuracy measures the bias in a measurement system that may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

- Laboratory error
- Sampling inconsistency
- Field and/or laboratory contamination
- Handling
- Matrix interference
- Preservation

Field and trip blanks, as well as matrix spike QC samples and laboratory control samples (LCSs), will be used to measure accuracy for project samples. Accuracy is calculated using the equation below:

$$\%R = \frac{SSR - SR}{SA} * 100$$

Where:

%R	=	% recovery
SSR	=	spike sample result
SR	=	sample result
SA	=	amount of spike added to sample

Representativeness

Representativeness expresses the degree to which sample data represent the characteristics of the media or matrix from which the data have been generated. Samples that are considered representative are properly collected to accurately characterize the nature and extent of contamination at a general sample location. Representativeness will be measured by using the methods (*e.g.*, sampling, handling, and preserving) in accordance with this sampling and analysis plan and the documents listed below.

1. "National Environmental Investigation Center (NEIC) Policies and Procedures Manual," May 1986, EPA 330/978-001R.
2. "USEPA Contract Laboratory Program Statement of Work for Organics Analysis Multi-Media, Multi-Concentration OLM04.2", May 1999.
3. "USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis and Classical Chemistry Parameters Multi-Media, Multi-Concentration ILM04.1", January 2000.

Representativeness will also be measured by the collection of field replicates (*e.g.*, volatile organics). Comparison of the analytical results from field replicates will provide a direct measure of individual sample representativeness.

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Comparability

Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. An acceptable level of comparability will be accomplished through the consistent use of accepted analytical and sampling methods.

Completeness

Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. Deficiencies in the data may be due to sampling techniques, poor accuracy, precision, or laboratory error. Although the deficiencies may affect certain aspects of the data, usable data may still be extracted from applicable samples. An evaluation of completeness necessarily involves an evaluation of the impact of missing data on the ability of the project to achieve its goals. This project has a goal of 90 percent completeness for the sample results. The equation used for completeness is presented below:

$$\%C = \frac{D * 100}{P * n}$$

Where:

D	=	number of confident quantification's
P	=	number of analytical parameters per sample requested for analysis
n	=	number of samples requested for analysis

As indicated previously, assessment of completeness alone does not provide a comprehensive evaluation of data quality; therefore, the percentage of unusable data will also be calculated by the following equations:

$$\begin{aligned}\% \text{Unusable Data} &= 100 \text{ times the number of sample results flagged "R" or "UR" divided} \\ &\quad \text{by the total number of results} \\ \% \text{Usable Data} &= 100 - \% \text{Unusable Data}\end{aligned}$$

The definitions for the qualifier codes R and UR are presented in the Region III Modifications to the National Function Guidelines.

5.3.2.2 Procedures for Monitoring PARCC Parameters

PARCC parameters will be monitored through the submission and analyses of many types of field and laboratory QC samples. These will include appropriate equipment rinsate blanks, trip blanks, laboratory method blanks, field and laboratory duplicates or replicates, matrix spikes, laboratory control samples, and calibration and check standards. Laboratory control samples (LCSs) are samples containing a known or true value that the laboratory prepares and analyzes concurrently with project samples. An LCS is most useful in judging analytical accuracy.

The frequency by which the field QC samples will be prepared and submitted is specified in Section 5.3.8 of this QAPP. The quantitation limits or detection limits for all analytes that will be examined for this investigation are specified in the appropriate sections of the USEPA CLP protocols.

5.3.2.3 PARCC Objectives

PARCC parameter objectives have been developed for the analysis of aqueous and solid samples for the parameters to be analyzed. The PARCC parameter objectives are based on analytical methods, historical data, and published guidelines/criteria presented in the USEPA CLP protocols. The data quality objectives with respect to PARCC are summarized on Tables 5-2 and 5-3.

5.3.2.4 Field Measurements

Measurement data will be generated in many field activities that are incidental to collecting samples for analytical testing or unrelated to sampling. These activities include, but are not limited to, the following:

- Documenting time and weather conditions
- Locating and determining elevations of sampling stations
- Collecting air monitoring measurements
- Determining sample collection depths
- Obtaining depth-to-water level and in situ field measurements

The general QA objective for field measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of the data through the documented use of standardized procedures. The procedures for performing these activities and the standardized formats for documenting these activities are presented in subsequent sections of this QAPP.

5.3.3 Sampling Procedures

The procedures to be followed as part of the collection of the soil and ground water samples were discussed in detail in Sections 5.2.1.3 and 5.2.2.5, respectively, of the Field Sampling Plan.

5.3.4 Sample Custody

Chain-of-custody (COC) is the process of tracking the handling of the sample from time of collection to analysis. The implementation of proper COC procedures provides defensible proof of sample and data integrity. A sample is under custody if: 1) it is in your possession; 2) it is in your view after being in your possession; 3) it was in your possession and you stored it in a secured area; and/or 4) it is in a designated secured area. To ensure proper custody of the samples collected during the Quarry No. 4 Demonstration Project is maintained at all times, the following procedures will be implemented in the field and laboratory.

Field Sample Custody

COC will be initiated in the field by the sampling team. All samples and sample containers will be kept under COC during field sampling activities. The custody of the samples and sample containers will be the responsibility of the Field Operations Manager (FOM) or personnel designated by FOM to collect the samples. The Field Operations Manager or the designated person completing the sampling will document each transfer of the samples and will be responsible for the custody of the samples until they are shipped to the laboratory.

Samples will only be collected in bottles supplied by CompuChem. If required, preservatives will be added to the sample bottles by the laboratory. After collecting the sample, a self-adhesive sample label will be attached to each container. The sample tags will contain the following information:

- Project name
- Sample collection date and time
- Sample designation
- Sampler(s) name
- Preservatives present in the sample bottle
- Analyses requested
- Sample media and indication of whether the sample is a grab or composite
- Initials of the sampler(s)

A copy of the CompuChem sample tags that will be used for the post-excavation sampling activities is provided in Attachment 5C. The sample tags will be completed using waterproof, non-eraseable black ink. After properly labeling the sample containers, they will be placed in zip-lock bags and then into ice filled coolers.

Prior to shipment, the sample tags on each bottle will be inspected to ensure that they have been properly completed and all information has been provided. Each sample container will be placed in a zip-lock plastic bag and then into a metal or molded plastic insulated cooler. The coolers will be packed with ice or dry ice to ensure that the temperature inside the cooler is maintained at 4 degrees Celsius during its trip back to the laboratory. The bottles will be packed in the cooler to minimize potential damage during shipping. Also, a thin layer of styrofoam peanuts will be placed on the bottom of the cooler and in the annulus between the bottles in an effort to further reduce any damage to the sample bottles during shipment.

A chain-of-custody record will be completed by the Field Operations Manager for each shipment of samples to the laboratory. The completed COC record will be sealed in a zip-lock bag and taped to the inside lid of the cooler. When samples are being transferred (i.e., from the field to the laboratory), each person involved in the transfer must sign off on the COC record. A copy of the CompuChem COC record that will be used for the soil and ground water sampling

activities is provided in Attachment 5C. The COC record will be completed using waterproof, non-erasable black ink.

After placing the COC record in the cooler, the cooler lid will be shut and fastened. Plastic shipping tape will be used to secure the drain and the lid. Two Custody Seals, one at each end of the cooler, will then be sealed to the cooler so that any tampering of the cooler (i.e., opening of the lid) can be documented by the laboratory. The identification number on the Custody Seals will be documented on the COC record and in the field logbook. A copy of the CompuChem Custody Seal that will be used for the post-excavation sampling activities is provided in Attachment 5C.

All sample coolers will be shipped directly to the laboratory using an overnight express delivery service following all appropriate DOT regulations. Since the COC record will be sealed inside the cooler, the courier will not have to sign the COC record. Upon receipt, the laboratory will inspect the cooler to make sure that it has not been tampered with and will compare the COC record to the contents of the cooler. A laboratory control number will be assigned to the samples and the samples will be logged into the laboratory computer sample inventory and tracking system.

All relevant information associated with the sample collection activities will be maintained in the field book. At a minimum, the following information will be maintained in the field logbook:

- Date and time of sampling
- Persons completing the sampling
- Weather conditions at the time the samples were collected
- Results of field screening observations
- Sample designation and analyses requested to be completed
- Decontamination procedures implemented
- Type of equipment used to collect the samples
- Number of laboratory bottles collected and submitted for each location
- Sample collection depths and locations
- Quality assurance/quality control samples collected
- The location and designation of any blind duplicate samples collected
- Any unusual conditions observed during the sample collection activities

Laboratory Sample Custody

The procedures to be implemented by the laboratory once they receive the samples to ensure proper COC are outlined in Section 5.5 of CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A.

5.3.5 Calibration Procedures

To ensure that the data collected meets the data quality objectives, various calibration procedures will need to be completed on field and laboratory equipment. These calibration procedures are discussed below.

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Field Calibration

The primary field equipment that will be used during the remedial activities, which will require calibration, includes the Photoionization Detector (PID), the water quality and depth-to-water meters and the Mini-Ram. The PID will be calibrated each day prior to its use using 100 ppm isobutylene and zero air following the procedures outlined in the User's Manual for the 2020 Photoionization Air Monitor, a copy of which is included in Attachment 5F. Ground water quality data (i.e., temperature, specific conductivity, pH and dissolved oxygen) will be obtained in the field utilizing a Horiba U-10 Water Quality meter. The U-10 Water Quality meter will be calibrated on a daily basis, or as needed, in accordance with the manufacturer's Instruction Manual, a copy of which is included in Appendix 5F. Depth-to-water measurements will be obtained from the monitoring wells using a Solinst water level meter or similar instrument. The water level meter will be operated in accordance with the manufacturer's Operating Instructions, a copy of which is included in Appendix 5F. The Mini-Ram is calibrated in the factory and will not need to be calibrated daily. However, the Mini-Ram will be zeroed in the field each day using the Z-Bag™ calibrator to ensure that it is still functioning properly. A copy of the Operations Manual for the Mini-Ram is included in Attachment 5F.

Laboratory Calibration

The calibration procedures and frequency of implementation to be performed by the laboratory are detailed in CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A.

5.3.6 Analytical Procedures

CompuChem will analyze the soil and ground water samples and associated quality assurance/quality control samples (QA/QC), a USEPA Contract Laboratory Program (CLP) approved laboratory located in Cary, N.C. The soil and perched water samples and associated QA/QC samples collected as part of this project will be analyzed for the Target Compound List volatile and semivolatile organic compounds and the Target Analyte List inorganics. The ground water and associated QA/QC samples collected, as part of this project will be analyzed for the list of COC to be developed upon implementation of the activities outlined in Section 4.0. This list will be included in the IRDR. The volatile and semivolatile organic analyses will be performed using USEPA Method OLM04.2 (GC/MS) and the metal analyses will be performed using USEPA Method ILM04.2 (ICP).

A summary of the analytical methods, sample holding times, sample containers, and preservations to be used, if any, are summarized in Table 5-1. The analytical method detection limits and the reporting limits for the various compounds/analytes to be tested for are discussed and presented in Section 3.6.3 of CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A.

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5.3.7 Data Validation, Reduction and Reporting

5.3.7.1 Overview

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data that require reduction. All the field data, such as those generated during field measurements, observations, and field instrument calibrations, will be entered directly into a bound field notebook or standard field form. Each project team member will be responsible for proofing all data transfers made, and the Field Operations Manager will proof 100 percent of all data transfers and initial entries after each day's field activities.

Upon receipt of the sample data packages, the laboratory data for all essential sample analyses will be qualitatively and quantitatively validated under the direction of the Data Validation Coordinator. The results of the field duplicates and blanks will also be evaluated at this time.

The purpose of the project data validation performed under the direction of the Data Validation Coordinator is to verify and retrace the path of the sample from the time of receipt for analysis to the time the final data package report is generated. The Data Validation Coordinator will review the entire deliverables package for Chain-of-Custody completeness, holding time compliance, blank contamination, instrument tuning, initial and continuing calibration, matrix spike recoveries, laboratory duplicate precision, and overall system performance. A detailed data validation report describing the difficulties encountered and shortcomings of the deliverables package as well as data quality issues will be prepared to assist in making decisions based on the analytical results.

Identification and Treatment of Outliers

Outliers represent unusually large or unusually small values in a population of observations. For example, if there is a waste stream that historically has detected levels of arsenic at 50 µg/L, a reported result of 200 µg/L or 5 µg/L for arsenic in a subsequent analysis of the waste stream should be investigated as an outlier. Outliers may be the result of a variety of factors (field-related or laboratory-related), including any of the following:

- Sampling artifact
- Sample integrity problem
- Incorrect transcription of sample identification in the field or laboratory
- Unique environmental conditions
- Faulty or defective instruments
- Inaccurate reading of meters
- Errors in recording of data
- Calculation errors
- Analytical errors

Procedures for the identification of outliers will be followed at both the analytical stage and at the ensuing data reduction stage. In addition, an independent assessment of the data is

performed to verify the quality of the data and to check for outliers due to transcription or calculation errors.

Outliers in laboratory data can be caused by errors in analysis or by site-specific conditions that are out of the control of the laboratory. Errors in the laboratory are most often identified in the data review and validation process. It is necessary to eliminate outliers from QC data because of the skewing effect, which can destroy the effectiveness of the QC data.

Outliers will be identified at the data reduction stage by the Data Validation Coordinator. When a particular value is suspected to be an outlier, the following steps will be taken:

- The Data Validation Coordinator will check other data from the same sample to see if these data are also anomalous. If multiple analytes from the analysis of a sample are suspected to be outliers, the sample may have to be resampled and reanalyzed, based on the Project Manager's discretion.
- The Data Validation Coordinator will interview the field crew and review the associated field notes. If the samplers demonstrate standard competency in the sampling procedure used at the time the sample with the anomalous value was obtained, sampling errors will be dismissed as a possible cause of the outlier. Problems with the sampling equipment or incorrect procedures used for sampling may be cause to invalidate suspected outliers.
- The Data Validation Coordinator will interview the analyst(s) involved with the generation of the anomalous result. The analyst(s) will be asked to examine his/her notes and calculations and, if possible, to rerun the sample for the specific parameter in question. Results of any samples rerun outside of holding time will be used for comparative purposes. Problems with the analysis of the sample or incorrect analytical procedures may be cause to invalidate the suspected outliers. Outliers caused by transcription errors or calculation errors, however, are generally identified and corrected, and valid sample results are obtained. The data validation of the analytical results (described in Section 5.3.7.4) will assist the Data Validation Coordinator in identifying transcription and calculation errors.
- If, after reviewing the field procedures and the laboratory analysis of the sample, the Data Validation Coordinator has not determined a valid reason for the anomalous result, the statistical approach of Dixon (Taylor, 1987) will be used to decide if the difference between the result and the historic data is statistically significant. If the result is determined to be an outlier by Dixon's test, the result will not be used for data qualification or for the decision-making process for risk assessment. Otherwise, the result will be considered a valid sample value (depending on other quality assurance measurements) and will be included in the decision-making process.

Rejection of any suspect data or outlier will only be at the discretion of the Data Validation Coordinator and Project Manager in conjunction with the Quality Assurance Officer.

- Field crew - If samplers demonstrate standard competency in the sampling procedure used at the time the sample with the anomalous value was obtained, sampling errors will be dismissed as a possible cause of the outlier.
- Analyst(s) - The analyst(s) will be asked to examine his/her notes and calculations and, if possible, to rerun the sample for the specific parameter in question. Results of any samples rerun outside of holding time will be used for comparative purposes.

Rejection of any suspect data or outlier will only be done by the Data Validation Coordinator and Project Manager in conjunction with the Quality Assurance Officer. The data will be rejected as an unacceptable outlier if:

- A problem with equipment or an incorrect procedure used during the sampling event is identified
- The reanalysis by the analyst generates a value that significantly differs from the value being examined

5.3.7.2 Data Reduction

A hardcopy sample summary package of the analytical data will be prepared in accordance with the requirements of the USEPA CLP protocols and delivered by the laboratory to Penn E&R. In addition, a complete data package will be prepared in accordance with the requirements of the USEPA CLP protocols and will be delivered by the laboratory to Environmental Standards. (Data package contents are described in the individual USEPA CLP protocols.) The final validated results will be included in the final quality assurance report; the final validated results will then be available to the Project Team for use in evaluation and interpretation.

5.3.7.3 Data Reporting

Data packages will be prepared by the laboratories according to the procedures described in the applicable USEPA CLP protocols. One copy of the complete data package will be delivered to Environmental Standards; this copy will be used in validating the analytical data. Penn E&R will receive a copy of the summary data package. The laboratory will be required to archive all raw data associated with this project for a period of 10 years and will notify Penn E&R prior to disposal of any project-associated information.

All aqueous analytical data generated by the laboratories will be reported in units of $\mu\text{g/L}$ (TCL organics and metals). All soil/solid sample analytical data generated by the laboratories will be reported in units of $\mu\text{g/kg}$ (TCL organics) and mg/kg (metals and wet chemistry parameters). Additionally, all soil/solid sample data will be reported on a dry-weight basis. Sample results will not be corrected for contamination detected in laboratory blanks.

An overall view of data flow from the point of raw data collection through storage of validated data is shown in Figure 5-3.

5.3.7.4 Data Validation

Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the project objectives and data quality objectives that were developed for this project. By maintaining thorough documentation of all decisions made during the sampling event, performing periodic field and laboratory audits, thoroughly reviewing and auditing (validating) the analytical data as they are generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, all field and laboratory data accuracy, precision, and completeness will be closely monitored.

Field Data Quality Assessment

To ensure that all field data are collected accurately and correctly, the Quality Assurance Officer will perform field audit(s) during key phases of sample collection to document that the appropriate procedures are followed with respect to sample (and QC sample) collection. These audits will include a thorough review of the field books and standard data collection forms used by the project personnel to ensure that all tasks are performed as specified in the FSP and QAPP.

The field audits will necessarily enable the data quality to be assessed with regard to the field operations. In addition, the Field Operations Manager will review all project logbooks at the conclusion of each day's sampling activities.

The evaluation (data review) of field blanks and other field QC samples will provide definitive indications of the data quality. If a problem arises, it should be possible to isolate the problem via the complete sample tracking and documentation procedures that will be performed. If such a problem does arise, corrective action can be instituted and documented. If data are compromised due to a problem, appropriate data qualifications will be used to identify the data.

Laboratory's Data Quality Assessment

For this project, the methods that the analytical laboratory will use to determine precision and accuracy and their acceptability are well defined in the specified USEPA CLP protocols. In general, for all routine parameters, accuracy is calculated through percent recovery. Similarly, precision is expressed as relative percent difference or percent relative standard deviation. Applicable equations are presented in the Quality Assurance Objectives for Measurements Section of this QAPP.

Independent Assessment Of Data Quality

All analytical data generated by the laboratory during the soil and ground water sampling activities will undergo a rigorous independent data review and validation prior to final evaluation and interpretation. The data validation will be performed by Environmental Standards. The data will be validated to determine compliance relative to the requirements of the specified analytical

protocol (USEPA CLP) and analytical data quality in accordance with the following guidance documents:

“Region III Modifications to National Functional Guidelines For Organic Data Review Multi-Media, Multi-Concentration (OLM01.0 – OLM01.9),” September 1994.

“Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses,” April 1993.

In addition, Environmental Standards will use professional judgment in qualifying the data for issues not addressed specifically in the above-referenced documents.

A preliminary review will be performed to verify that all necessary paperwork (Chain-of-Custody Records, analytical reports, laboratory personnel signatures, *etc.*) and deliverables for the analyses are present.

A detailed quality assurance review will be performed to independently verify compliance to the required analytical protocols and to determine the qualitative and quantitative reliability of the data as presented. The review will include a detailed analysis and interpretation of all data generated by the laboratory. Table 5-4 presents some of the items examined during the quality assurance review.

Quality assurance reports will be prepared to summarize the data validation findings and these reports will be distributed to the Project Team to ensure the validated data is used for the final evaluation and interpretation. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration such that the analytical results can be best utilized.

Based on the quality assurance review, specific codes will be placed next to results in the database to provide an indication of the quantitative and qualitative reliability of the results. Data validation qualifier codes will be those defined in the above-referenced documents. During the course of the data review, a full organic and inorganic support documentation package that will provide backup information and will accompany all qualifying statements presented in the quality assurance review will be prepared.

Once the review has been completed, the Data Validation Coordinator will submit the report to Penn E&R. These approved quality assurance reviews will be signed and dated by the Data Validation Coordinator.

Management Data Quality Assessment

The analytical data generated from the investigation are validated, qualified, and submitted to the Penn E&R Project Managers. The quality of the data will be assessed from an overall management perspective by an evaluation of the analytical results with respect to the project objectives and data quality objectives. The evaluation will determine if the generated data are adequate to meet the objectives and/or may identify the need for new data to fill data gaps.

5.3.8 Internal Quality Control

This Section of the QAPP outlines the internal quality control (QC) checks that will be used to evaluate the precision and accuracy of analytical data. The field QC checks are used to identify potential problems associated with sample handling and procedures, and laboratory QC checks are used to identify potential problems with sample preparation and analysis. The data quality objective criteria for these internal QC checks are presented in Tables 5-2 and 5-3.

Field Internal Quality Control Checks

Field Internal Quality Control Checks will be utilized during the remedial activities through the collection and analysis of the following QA/QC samples:

Trip Blanks

One trip blank will accompany each shipment of samples to the laboratory. The trip blank will consist of deionized water in a 40-mil vial supplied by the laboratory with the bottleware. The trip blanks will be preserved with hydrochloric acid. The trip blank will accompany the sampling team during the sampling activities and will serve as a QC check for possible cross-contamination from external sources and the analytical method. The trip blanks submitted for this project will be analyzed for the Target Compound List (TCL) volatile organic compounds.

Equipment Rinsate Blanks

One equipment rinsate blank will be generated per twenty environmental samples collected per matrix. The equipment rinsate blanks will be collected in the field by pouring deionized water over decontaminated sampling equipment used to collect the post-excavation samples. The deionized rinsate water will be collected directly into laboratory supplied sample containers. The rinsate blanks will be used to confirm the effectiveness of the field decontamination procedures. The field rinsate blanks will be analyzed for the same compounds that the soil/ground water samples are analyzed.

Blind Duplicates

One blind duplicate sample will be collected per twenty environmental samples submitted per matrix for laboratory analysis. The blind duplicate samples will be collected by generating twice the required sample volume at the selected sample location for soils. The volatile organic fraction for both the environmental sample and the blind duplicate will be collected first. After homogenization, the remaining sample containers for both the environmental sample and the blind duplicate will be filled. For ground water, the appropriate bottleware for the environmental samples will be filled first followed by the bottleware for the blind duplicate. The results for blind duplicate samples will be compared to those generated for the corresponding environmental samples to check analytical and sampling precision. The blind duplicates will be analyzed for the same compounds that the soil/ground water samples are analyzed.

Matrix Spike/Matrix Spike Duplicates

Due to the limited number of soil samples to be collected, a site-specific matrix spike and matrix spike duplicate will not be collected during the proposed soil sampling activities. For the ground water sampling, one matrix spike and one matrix spike duplicate will be collected per quarterly sampling event for laboratory analysis. These samples will be spiked by the laboratory to assess accuracy and precision and possible effects of matrix interference. The matrix spike and matrix spike duplicates will be collected by generating three times the required sample volume at the selected monitoring well location. The matrix spike and spike duplicates will be analyzed for the same compounds that the ground water samples are analyzed.

Internal Laboratory Quality Control Checks

The internal quality control checks to be used by the laboratory to monitor accuracy, precision, external contamination and extraction efficiency, among others, are detailed in CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A.

5.3.9 Performance and System Audits

The field and laboratory performance/systems audits to be completed are discussed below.

Field Audits

Penn E&R's Quality Assurance Officer will complete one on-site system field audit. The primary objectives of this audit will be to ensure that all on-site activities are being completed in accordance with the procedures outlined in this RDWP. The audit will include verification and documentation of the following:

- All drilling and sampling activities are being completed in accordance with the Site-Specific Health and Safety Plan and Sampling and Analysis Plan.
- All equipment leaving the site and used to collect soil samples are being properly decontaminated
- Completeness and accuracy of the Chain-of-Custody forms, sample labels/tags, and sample packing and shipping procedures
- Completeness and accuracy of field note books including the collection of detailed daily notes regarding on-site visitors, problems encountered and corrective actions implemented, samples collected and shipped to the laboratory on a daily basis

The results of the on-site audit will be summarized in the field logbook and in a written report. The audit report will be prepared by the Quality Assurance Officer and reviewed by the Project Manager. Any deficiencies noted will be addressed during the audit but will be noted in the report along with the appropriate corrective actions that were implemented.

Laboratory Audits

CompuChem is a USEPA CLP approved laboratory and has a comprehensive performance and system audit program in-place. A description of CompuChem's performance and system audit program along with the frequency of the audits is detailed in their Quality Assurance Manual, a copy of which is included in Attachment 5A.

5.3.10 Preventive Maintenance

The field and laboratory preventive maintenance activities that will be implemented to reduce downtime and potential impacts on data quality are discussed below.

Field Maintenance

The PID, water quality and depth-to-water meters, and Mini-Ram are maintained on a regular basis before and after each use. The general maintenance activities that are required to ensure the proper functioning of these instruments are described in Attachment 5F. The Field Operations Manager will ensure that an inventory of spare parts for these meters and other pieces of equipment is maintained. Spare parts that often require replacement (i.e., filters, bulbs) will be maintained on-site. The preventive maintenance for sampling equipment will include ensuring that the equipment is clean and in good condition for its intended use, sample bottles are clean and not damaged, and the appropriate sampling equipment is available and on-site to implement the required sampling. Also, the Field Operations Manager will ensure that a sufficient supply of health and safety equipment (i.e., boots/tyvek, gloves) and decontamination supplies (i.e., soap and tap water, acetone, brushes) are maintained on-site.

Laboratory Maintenance

CompuChem is a USEPA CLP approved laboratory and has a comprehensive maintenance program in-place. A description of CompuChem's maintenance program is detailed in their Quality Assurance Manual, a copy of which is included in Attachment 5A. Also, Compuchem generally has more than one instrument required to complete the various analyses required as part of this project. Therefore, if a piece of equipment malfunctions or does not meet the required measurement criteria, other instruments can be used for the required analyses.

5.3.11 Procedures To Be Used To Evaluate Data Quality

The procedures to be used to evaluate precision, accuracy, and completeness are presented in Sections 5.3.2 and 5.3.7 of this QAPP. Also, specific procedures to be followed by the analytical laboratory are outlined in CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A. Also, field and laboratory audits, as described in Section 5.3.9, will also be used in the field and by the laboratory to evaluate precision, accuracy, and completeness.

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5.3.12 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures, deviations from approved procedures or methodologies, or out of control quality control performance that can affect data quality. The need for corrective action may be determined by any member of the project team including samplers, analysts, supervisors, quality assurance personnel, or laboratory managers. The detection of system and performance problems and the corrective actions methods implemented in the field during monitoring and sample collection activities will be documented in the field book and the Monthly Progress reports. Any problems that cannot be resolved by the Field Operations Manager will be brought to the attention of the Project Manager. The Project Manager and, if required, the USEPA Remedial Project Manager, will determine the corrective action to be taken, if any. The Project Manager will be responsible for appropriate follow-ups to ensure that corrective actions are implemented, complete and effective, and the problem is not repeated.

The corrective actions that will be implemented during data validation for any measurements that do not meet the PARCC criteria established for this site, as summarized in Tables 5-2 and 5-3, are discussed in Section 5.3.7.

Corrective action measures and procedures to be implemented by the analytical laboratory are outlined in Section 13 of CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A.

5.3.13 Quality Assurance Reports

This Section of the QAPP outlines the Quality Assurance reports that will be developed as part of the implementation of the Quarry No. 4 Demonstration Project.

Monthly Progress Reports will be developed and submitted to the USEPA. These reports will include a summary of the activities completed on the project during the previous month including a discussion of all field sampling and remedial activities. The Monthly Progress report will include a section dealing specifically with Quality Assurance issues. The QA Section of the Monthly Progress reports will include a summary of any significant QA/QC issues identified and the corrective actions implemented, a discussion of the results of any audits performed, and a discussion of any required modifications to the FSP or QAPP. The Project Manager will also develop Summary Memorandums for submittal to the PADEP to address any significant QA issues that need to be addressed in a timelier manner.

As discussed in Section 5.3.7, a separate QA Report will be prepared to summarize the data validation findings. This report will include a discussion of the usability of the data including appropriate qualifiers to provide an indication of the quantitative and qualitative reliability of the results.

Section 10 in CompuChem's Quality Assurance Manual, a copy of which is included in Attachment 5A, presents the laboratory's procedures for QA reports to management.

The Final Remedial Design Report to be completed at the completion of the Quarry No. 4 Demonstration Project will also include a specific section that will discuss all pertinent QA issues identified and addressed during the project

Initially, Penn E&R will store all original documents in a secured data storage area at our offices in Hatfield, PA. These documents will include all field notes, QA/QC audits, laboratory data reports, work plans and reports, and all other records and documents generated during the implementation of the Quarry No. 4 Demonstration Project. After completion of the remedial activities, these records will be transferred to LPT's Corporate offices. LPT will maintain these files for 10 years after receiving a Certification of Completion of the Work from the USEPA.

TABLE 5-1

**SUMMARY OF ANALYSES TO BE COMPLETED, SAMPLE CONTAINERS,
PRESERVATION AND HOLDING TIMES FOR SOIL, GROUNDWATER AND QA/QC
SAMPLES TO BE COLLECTED AS PART OF THE QUARRY NO. 4 DEMONSTRATION PROJECT**

ANALYSES TO BE COMPLETED ⁽¹⁾	ANALYTICAL METHOD	HOLDING TIME ⁽²⁾		CONTAINERS		VOLUME OF SAMPLE REQUIRED		PRESERVATION	
		Soil	Water	Soil	Water	Soil	Water	Soil	Water
Volatiles	OLM04.2 (GC/MS)	14 days	14 days	Encore™ Sampler	40-mil glass with teflon lids	15 grams	3-4 mil vials	Cool to 4°C	HCL, Cool to 4°C
Semivolatiles	OLM04.2 (GC/MS)	14 days	14/40 days ⁽³⁾	8 oz. Glass	1-liter amber glass	50 grams	2 liters	Cool to 4°C	Cool to 4°C
Inorganics	ILM04.1 (ICP)	180 days	180 days	8 oz. Glass	500-mil plastic	30 grams	500 mil	Cool to 4°C	HNO ₃ , Cool to 4°C

Notes

- (1) - The soil and any perched water detected on top of the quarry, as well as any associated QA/QC samples, will be analyzed for the Target Compound List (TCL) volatile and semivolatile organic compounds, and the Target Analyte List (TAL) inorganics (i.e. metals and cyanides). The groundwater samples, and associated QA/QC samples, will be analyzed for the list of contaminants of concern to be developed after completion of the Task 1 activities, which will be included in the IRDR.
- (2) - Holding times are based upon time of collection.
- (3) - The laboratory has 14 days to extract samples for analysis of semivolatile organic compounds, and 40 days from extraction to analyze.

TABLE 5-2

DATA QUALITY OBJECTIVES

FOR THE SOIL AND GROUND WATER SAMPLING TO BE COMPLETED AS PART OF THE

QUARRY NO. 4 DEMONSTRATION PROJECT

DQO Parameter	Aqueous Criteria	Soil/Solid Criteria
Precision	Table 5-3	Table 5-3
Accuracy	Table 5-3	Table 5-3
Sensitivity	Less than or equal to the CRQLs specified in the US EPA CLP OLM04.2	Less than or equal to the CRDLs specified in the US EPA CLP ILM05.0
Representativeness (Field Duplicates)	The relative percent difference (RPD) between the results of aqueous field duplicates should be less than or equal to 20% for results greater than 5 X the QL. The difference between results in aqueous field duplicates should be less than the QL when at least one result is less than or equal to 5X the QL.	The relative percent difference (RPD) between the results of soil/solid field duplicates should be less than or equal to 40% for results greater than 5 X the QL. The difference between results in soil/solid field duplicates should be less than 2X the QL when at least one result is less than or equal to 5X the QL.
Completeness	90%	90%
Comparability	Based on Precision and Accuracy and Media Comparison	Based on Precision and Accuracy and Media Comparison

Notes:

DQO - Data Quality Objective

QL - Quantitation Limit

TABLE 5-3

**ACCURACY AND PRECISION DATA QUALITY OBJECTIVES
FOR THE SOIL AND GROUND WATER SAMPLES TO BE COLLECTED AS PART OF THE
QUARRY NO. 4 DEMONSTRATION PROJECT**

Parameter	Audit	Analytes	Aqueous Control Limits	Solid Control Limits
TCL Volatile Compounds	Lab blank, trip blank, or field blank	All TCL Compounds	<5X the QL for common lab contaminants, and <QL for all other compounds.	<5X the QL for common lab contaminants, and <QL for all other compounds.
	Matrix Spike Duplicate Precision	1,1-Dichloroethene	<14%RPD	<22%RPD
		Trichloroethene	<14%RPD	<24%RPD
		Benzene	<11%RPD	<21%RPD
		Toluene	<13%RPD	<21%RPD
		Chlorobenzene	<13%RPD	<21%RPD
	Matrix Spike Recovery	1,1-Dichloroethene	61-145%	59-172%
		Trichloroethene	71-120%	62-137%
		Benzene	76-127%	66-142%
		Toluene	76-125%	59-139%
		Chlorobenzene	75-130%	60-133%
	Laboratory Control Sample Recovery	1,1-Dichloroethene	61-145%	59-172%
		Trichloroethene	71-120%	62-137%
		Benzene	76-127%	66-142%
		Toluene	76-125%	59-139%
		Chlorobenzene	75-130%	60-133%
	Surrogate Spike Recoveries	4-Bromofluorobenzene	86-115%	59-113%
		1,2-Dichloroethane-d4	76-114%	70-121%
		Toluene-d8	88-110%	84-138%

TABLE 5-3 - CONTINUED

**ACCURACY AND PRECISION DATA QUALITY OBJECTIVES
FOR THE SOIL AND GROUND WATER SAMPLES TO BE COLLECTED AS PART OF THE
QUARRY NO. 4 DEMONSTRATION PROJECT**

Parameter	Audit	Analytes	Aqueous Control Limits	Solid Control Limits
TCL Semivolatile Compounds	Lab blank, trip blank, or field blank	All Semivolatile Compounds	<5X the QL for phthalate esters and <QL for all other compounds.	<5X the QL for phthalate esters and <QL for all other compounds.
	Matrix Spike Duplicate Precision	Phenol	<42%RPD	<35%RPD
		2-Chlorophenol	<40%RPD	<50%RPD
		N-Nitroso-di-n-propylamine	<38%RPD	<38%RPD
		4-Chloro-3-methylphenol	<42%RPD	<33%RPD
		Acenaphthene	<31%RPD	<19%RPD
		4-Nitrophenol	<50%RPD	<50%RPD
		2,4-Dinitrotoluene	<38%RPD	<47%RPD
		Pentachlorophenol	<50%RPD	<47%RPD
		Pyrene	<31%RPD	<36%RPD
	Matrix Spike Recovery	Phenol	12-120%	26-90%
		2-Chlorophenol	27-123%	25-102%
		N-Nitroso-di-n-propylamine	41-116%	41-126%
		4-Chloro-3-methylphenol	23-97%	26-103%
		Acenaphthene	46-118%	31-137%
		4-Nitrophenol	10-80%	11-114%
		2,4-Dinitrotoluene	24-96%	28-89%
		Pentachlorophenol	9-103%	17-109%
		Pyrene	26-127%	35-142%
	Laboratory Control Sample Recovery	Phenol	12-120%	26-90%
		2-Chlorophenol	27-123%	25-102%
		N-Nitroso-di-n-propylamine	41-116%	41-126%
		4-Chloro-3-methylphenol	23-97%	26-103%
		Acenaphthene	46-118%	31-137%
		4-Nitrophenol	10-80%	11-114%
		2,4-Dinitrotoluene	24-96%	28-89%
		Pentachlorophenol	9-103%	17-109%
		Pyrene	26-127%	35-142%
	Surrogate Spike Recoveries	Nitrobenzene-d5	35-114%	23-120%
		2-Fluorobiphenyl	43-116%	30-115%
		p-Terphenyl-d14	33-141%	18-137%
		Phenol-d5	10-110%	24-113%
		2-Fluorophenol	21-110%	25-121%
		2,4,6-Tribromophenol	10-123%	19-122%
		2-Chlorophenol	33-110%	20-130%
		1,2-Dichlorobenzene-d4	16-110%	20-130%

TABLE 5-3 - CONTINUED

**ACCURACY AND PRECISION DATA QUALITY OBJECTIVES
FOR THE SOIL AND GROUND WATER SAMPLES TO BE COLLECTED AS PART OF THE
QUARRY NO. 4 DEMONSTRATION PROJECT**

Parameter	Audit	Analytes	Aqueous Control Limits	Solid Control Limits
Metals	Lab blank, trip blank, or field blank	All Metals	<CRDL for all metals	<CRDL for all metals
	Laboratory Duplicate Precision	All Metals	<20%RPD	<40%RPD
	Matrix Spike Recovery	All Metals	75-125%	75-125%
	Laboratory Control Sample Recovery	All Metals	80-120%	70-130%

Notes:

QL - Quantitation Limit
 TCL - Target Compound List
 CRDL - Contract Required Detection Limit
 RPD - Relative Percent Difference

TABLE 5-4

**ITEMS TO BE EXAMINED DURING THE
QUALITY ASSURANCE REVIEW FOR SOIL AND GROUNDWATER SAMPLES
COLLECTED AS PART OF THE QUARRY NO. 4 DEMONSTRATION PROJECT**

<u>Areas Examined</u>	<u>Applicability</u> (organic, inorganic, both)
Field and laboratory Chain-of-Custody Records (field notes, etc.)	Both
Laboratory narrative and QC summaries	
Holding times	Both
Extraction/digestion logs	Both
Blanks -field & laboratory (accuracy)	Both
Instrument tune	Organic
Standards	Both
Linearity	Both
Sensitivity/stability	Both
Selectivity/specificity	Both
EPA criteria	Both
Variability of technique (internal standards)	Organic
Analyte breakdown	Organic
Analytical sequence	Organic
ICP interference	Inorganic
Control Standards	Inorganic
Serial Dilutions	Inorganic

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TABLE 5-4 - CONTINUED

**ITEMS TO BE EXAMINED DURING THE
QUALITY ASSURANCE REVIEW FOR SOIL AND GROUNDWATER SAMPLES
COLLECTED AS PART OF THE QUARRY NO. 4 DEMONSTRATION PROJECT**

Areas Examined

Applicability

(organic, inorganic, both)

Samples

Detection limits	Both
Instrument printouts	Both
ICP data	Inorganic
AA data	Inorganic
GC data	Organic
GC/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative Identification	Both
Mass spectra	Organic
Pesticide/Aroclor results	Organic
Tentatively identified compounds	Organic
Quantitative Reliability	Both
Calculations/equations	Both
Matrix spikes (accuracy)	Both
Bias	
Matrix spike duplicates	Organic
Bias	
Accuracy and precision	
Surrogate spikes	Organic
Bias	
Duplicates (field & laboratory)	Both
Precision	
Representativeness	
Post-digestion spikes (graphite furnace AA)	Inorganic
Matrix effects	



original
(red)

FILL
 ROAD
 RAILROAD

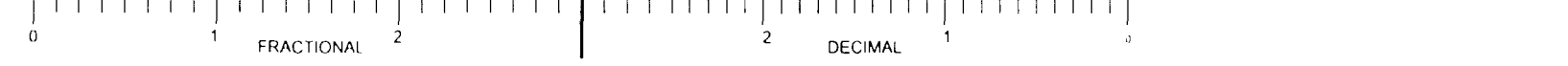
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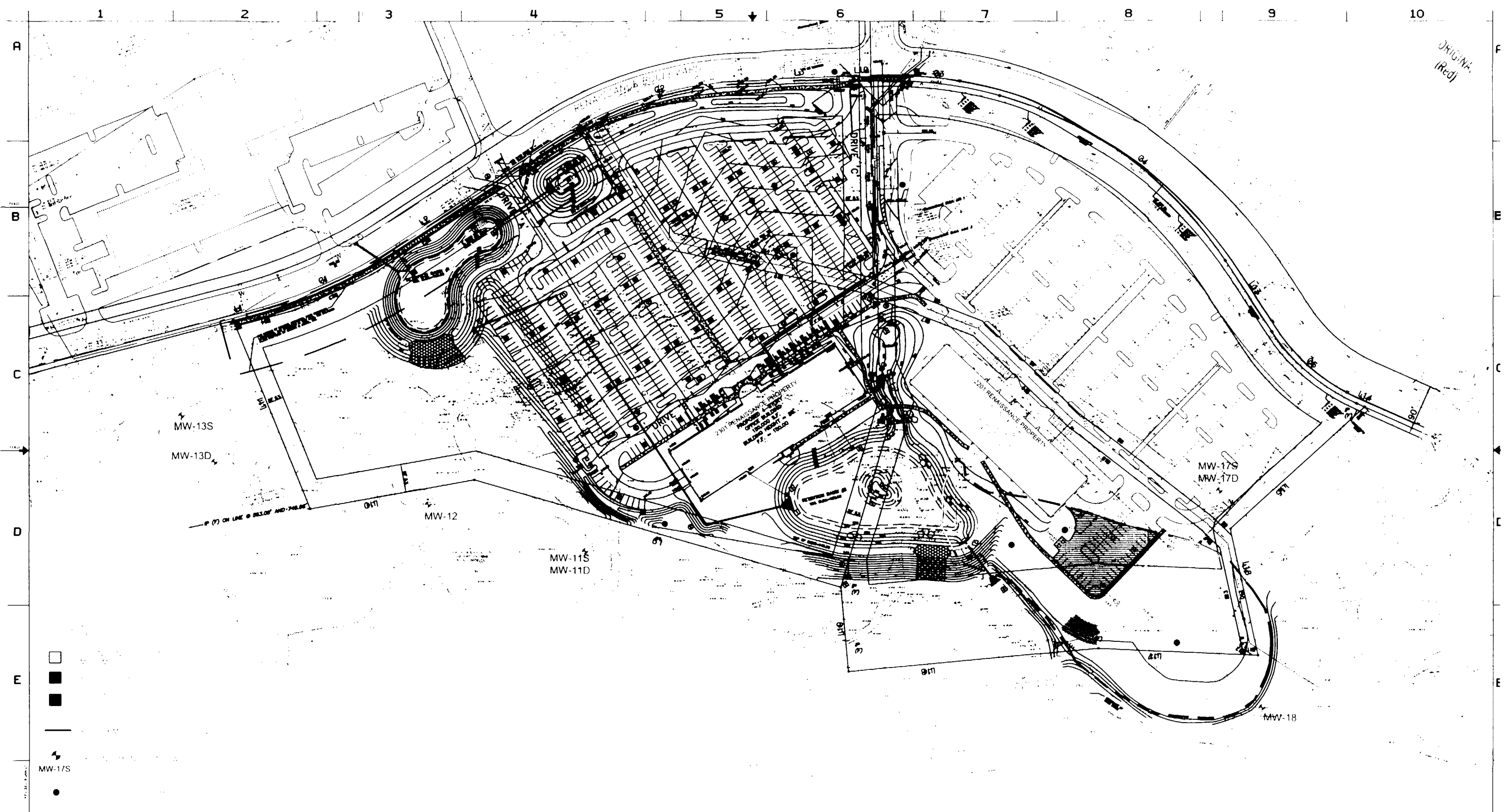
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FIGURE 5-1
SITE LAYOUT MAP FOR 2201/2301
RENAISSANCE BOULEVARD SHOWING
THE APPROXIMATE LIMITS
OF QUARRY NO. 4

PROJECT NO. 4236 SCALE 1" = 100' BY: JMD REVIEWED: _____ PENN. E&R DRAWING NO. 4236-034 (5)	APPROVED: _____ DATE: _____ FIGURE NO. _____ REV. _____
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NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED





ORIGINAL
(Red)

NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ADD.	REVISION	BY	DATE

0 1 2 FRACTIONAL

2 1 3 DECIMAL

Penn E&R
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PROJECT NO. 4236	FIGURE NO. 5.2
SCALE 1" = 100'	SITE LAYOUT MAP FOR 2201/2301 RENAISSANCE BOULEVARD SHOWING PROPOSED LOCATIONS AT WHICH SOIL BORINGS WILL BE INSTALLED AS PART OF THE QUARRY NO. 4 DEMONSTRATION PROJECT
DATE 12/1/87	DATE 12/1/87
APPROVED [Signature]	APPROVED [Signature]
PENNER, TRAVING, INC.	FIGURE NO. 5.2
4236-034	REV. 1